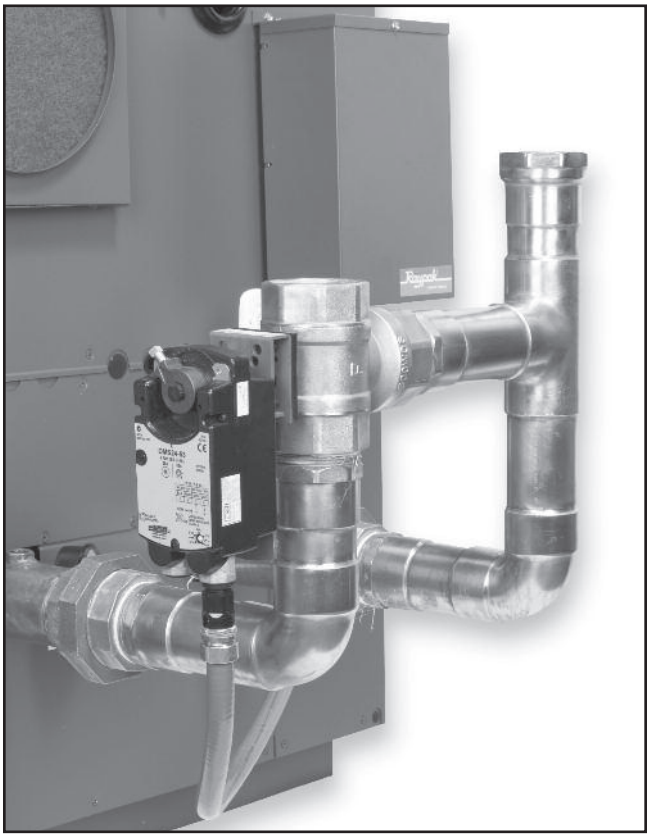
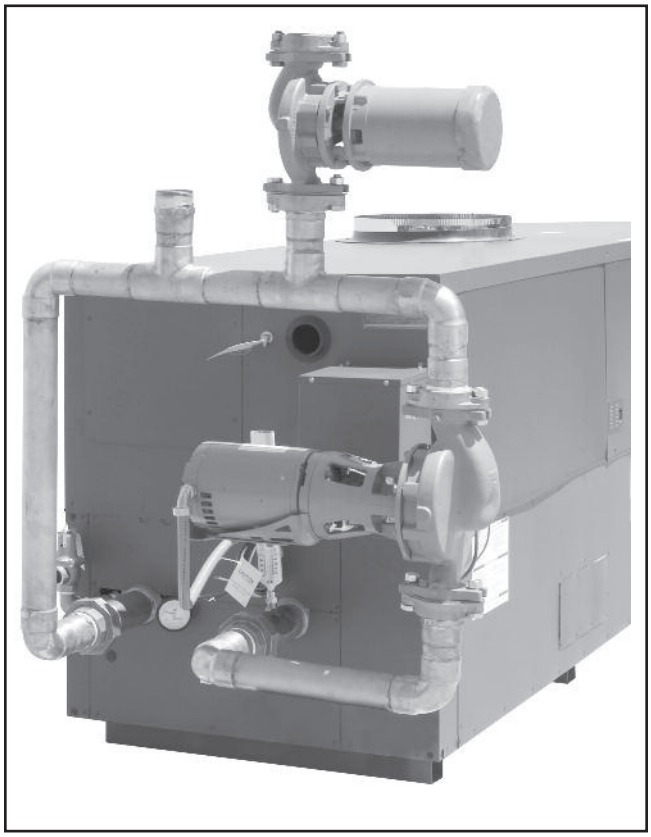
INSTALLATION & OPERATING INSTRUCTIONS

Cold Water Start & Cold Water Run





For Hi Delta, MVB & Raytherm Heaters & Boilers

This manual should be maintained in legible condition and kept adjacent to the heater or in another safe place for future reference.

Raypak®

A Rheem® Company

Catalog No: 1000.57H Effective: 07-22-10 Replaces: 09-01-09 P/N 241275 Rev. 9

Rev. 9 reflects the following:
Changes to: “Connecting the Valve Assembly” on page 6, Fig. 10 on page 9, Figs 11-13 on page 10, Cold Water Start Troubleshooting Guide on page 14. Wiring Diagrams on pages 16 & 17, Cold Water Run piping on page 26, Piping Diagram for Heating Applications on page 29, CWR parts list on page 39
Additions: Note and Fig. 1 on page 6, Caution on page 7, “Mounting Brackets” on page 11 through “Actuator” on page 13, “Actuator to Valve Orientation” on page 19 through “Connecting the Actuator” on page 20, Piping Diagram for Pool Applications on page 29, Wiring Diagram on page 33
Deletions: None

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WARNINGS

Pay Attention to These Terms

DANGER:	Indicates the presence of immediate hazards which will cause severe personal injury, death or substantial property damage if ignored.
WARNING:	Indicates the presence of hazards or unsafe practices which could cause severe personal injury, death or substantial property damage if ignored.
CAUTION:	Indicates the presence of hazards or unsafe practices which could cause minor personal injury or product or property damage if ignored.
NOTE:	Indicates special instructions on installation, operation, or maintenance which are important but not related to personal injury hazards.

NOTE: Minimum 18 AWG, 105°C, stranded wire must be used for all low voltage (less than 30 volts) external connections to the unit. Solid conductors should not be used because they can cause excessive tension on contact points. Install conduit as appropriate. All high voltage wires must be the same size (105°C, stranded wire) as the ones on the unit or larger.

NOTE: Piping diagrams in this manual are not intended to replace an engineered piping system.

NOTE: Consult the factory for units with a 30 pound pressure relief valve (PRV).

GENERAL SAFETY

To meet commercial hot water use needs, the high limit safety control on this water heater is adjustable up to 210°F. However, water temperatures over 125°F can cause instant severe burns or death from scalds. When supplying general purpose hot water, the recommended initial setting for the temperature control is 125°F.

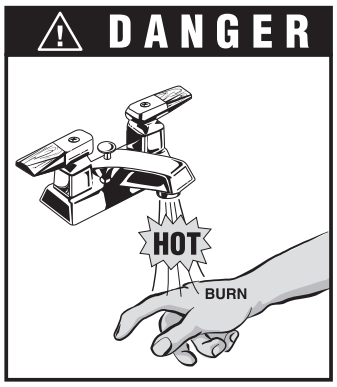
Safety and energy conservation are factors to be considered when setting the water temperature on the thermostat. The most energy-efficient operation will result when the temperature setting is the lowest that satisfies the needs of the application.

Water temperature over 125°F can cause instant severe burns or death from scalds. Children, disabled and elderly are at highest risk of being scalded.

- Feel water before bathing or showering.
- Temperature limiting valves are available.

NOTE: When this water heater is supplying general purpose hot water for use by individuals, a thermostatically controlled mixing valve for reducing point of use water temperature is recommended to reduce the risk of scald injury. Contact a licensed plumber or the local plumbing authority for further information.

Maximum water temperatures occur just after the heater's burner(s) have shut off. To determine the water temperature being delivered, turn on a hot water faucet and place a thermometer in the hot water stream and read the thermometer.



Water temperature over 125°F can cause instant severe burns or death from scalds.

Children, disabled, and elderly are at highest risk of being scalded.

See instruction manual before setting temperature at water heater.

Feel water before bathing or showering.

Temperature limiting valves are available, see manual.

Time/Temperature Relationships in Scalds

The following chart details the relationship of water temperature and time with regard to scald injury and may be used as a guide in determining the safest water temperature for your applications.

Water Temp.	Time to Produce Serious Burn
120°F	More than 5 minutes
125°F	1-1/2 to 2 minutes
130°F	About 30 seconds
135°F	About 10 seconds
140°F	Less than 5 seconds
145°F	Less than 3 seconds
150°F	About 1-1/2 seconds
155°F	About 1 second

Table courtesy of The Shriners Burn Institute

Table A: Time to Produce Serious Burn

COLD WATER START

Before beginning the installation, it's important to first inspect the system and determine what materials you will need. Some parts are included with the controller while others you will need to provide.

1 Control Box

1 Temperature Sensor

1 Valve assembly with actuator (Shipped separately)

Wiring and mounting hardware (Provided by installer)

NOTE: After testing at the factory it may be prudent to ship the piping assembly disassembled and attached to the heater pallet. This is done to avoid shipping damage and it must be reassembled on the jobsite. Use Fig. 1 to assist in reassembling the piping.

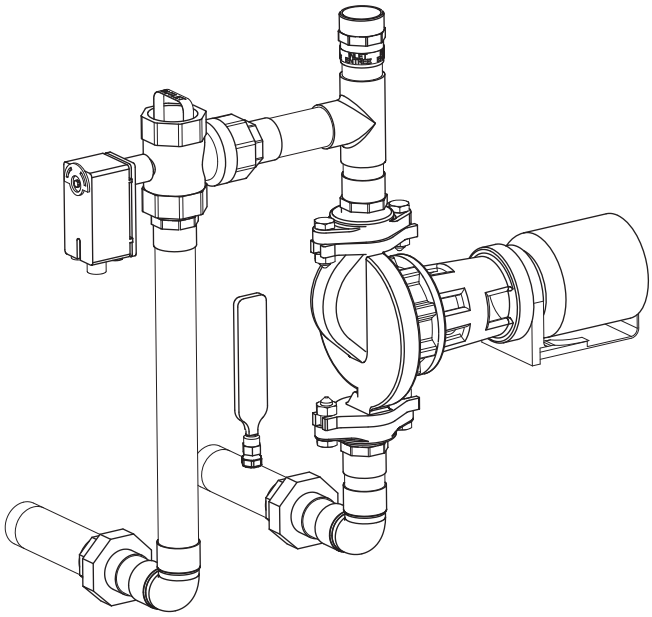


Fig. 1: Cold Water Start Assembly

Installation

Check the Power Source

CAUTION: Do not use for swimming pool applications

WARNING: Using a multi-meter, check the following voltages at the breaker panel prior to connecting any equipment. Make sure proper polarity is followed and house ground is proven.

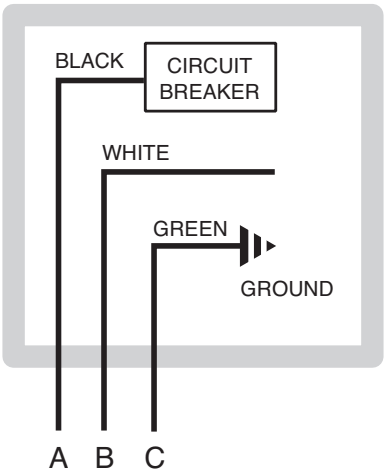


Fig. 2: Wiring Connections

Check the power source:

AC = 108 VAC Minimum, 132 VAC MAX
AB = 108 VAC Minimum, 132 VAC MAX
BC = <1 VAC Maximum

Mounting the Control Box

The control box should be mounted on the side of the heater to which the system piping and valve assembly are to be attached as shown in Figs. 4–8. The controller should be mounted so as to provide maximum support by using the mounting holes provided on the base of the controller to the side center brace on the heater. On MVB and Hi Delta models, locating dimples are provided for ease of drilling the mounting holes. You will need to drill mounting holes through the heater side panel for the routing of wiring and the sensor.

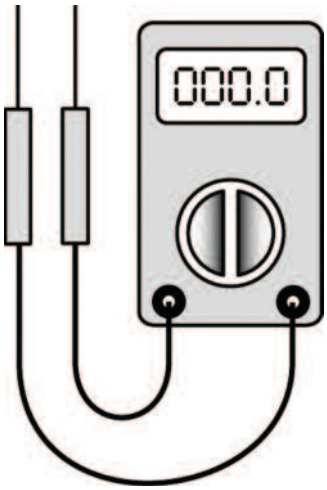


Fig. 3: Multi-meter

Installing the Temperature Sensor

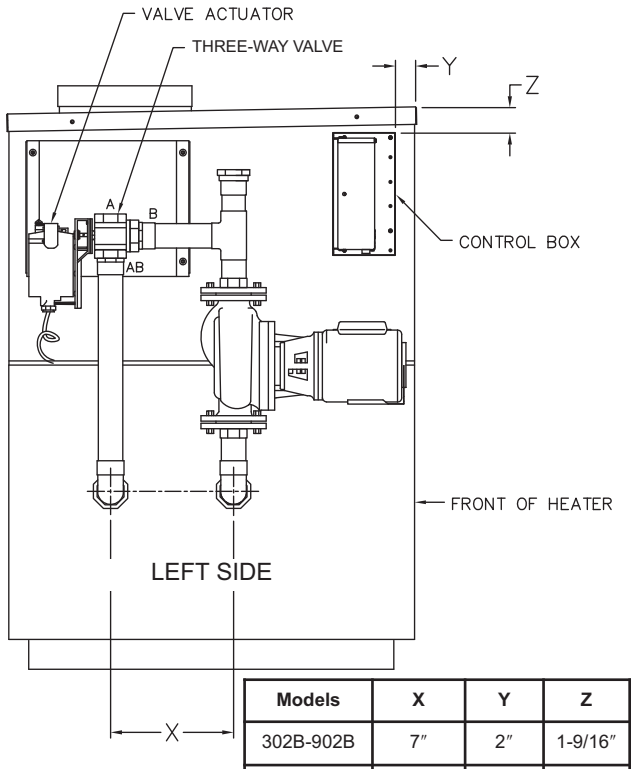
Avoid routing wiring on or near other electrical wires, conduit, motors, spark igniters or other sources of high intermittent voltage or current. The sensor should be placed in the dry well on the inlet header, or as indicated in the piping for multiple heaters, as shown on page 21. Ensure it is installed using thermal paste (field supplied) and that it is held firmly at the bottom of the well.

Connecting the Valve Assembly

Connect the valve assembly into the bypass piping. The branch (port B) is connected to the crossover pipe (bypass between inlet and outlet). The actuator tail stock should be oriented to point down. Refer to the Actuator to Valve Orientation section.

Route wiring from the valve to the controller thru one of the bottom panel conduit knockouts to TB2. Refer to the wiring diagram provided on the inside of the controller cover assembly.

CAUTION: Miswiring the actuator may cause unwarrantable damage. Verify the wire colors against the actuator make and model.



Models	X	Y	Z
302B-902B	7″	2″	1-9/16″
992B-2342B	13-1/4″	1-5/16″	6-5/8″

Fig. 4: Component Locations—Hi Delta

NOTE: Four knockouts are located on the bottom of the control for ease of installation.

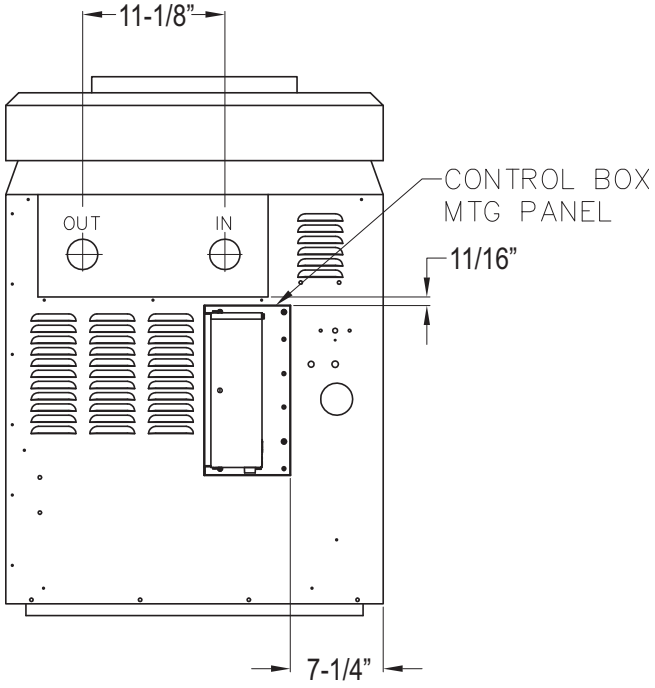


Fig. 5: Component Locations—Raytherm Models 514–824

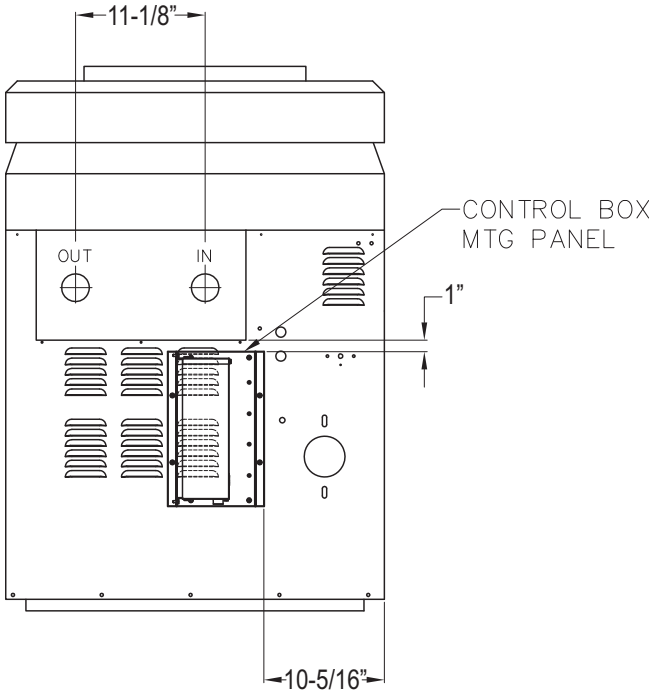


Fig. 6: Component Locations—Raytherm Models 926–1826

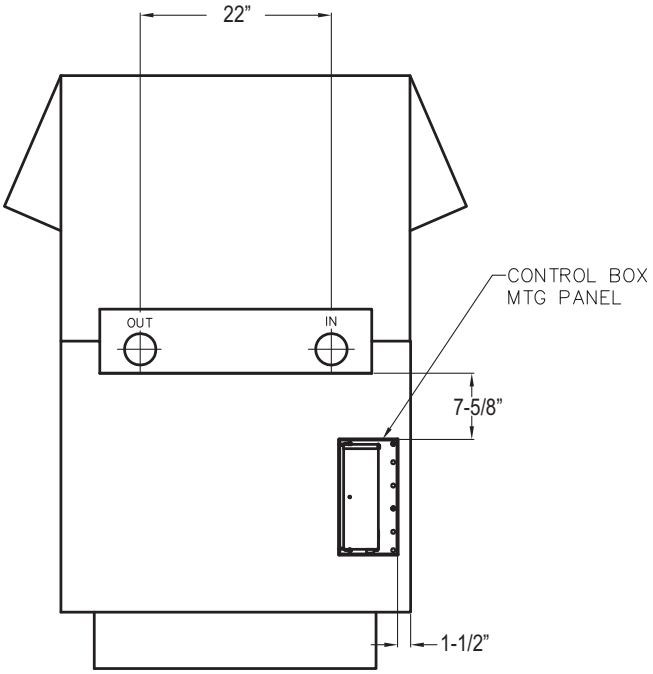


Fig. 7: Component Locations—Raytherm Models 2100–4001

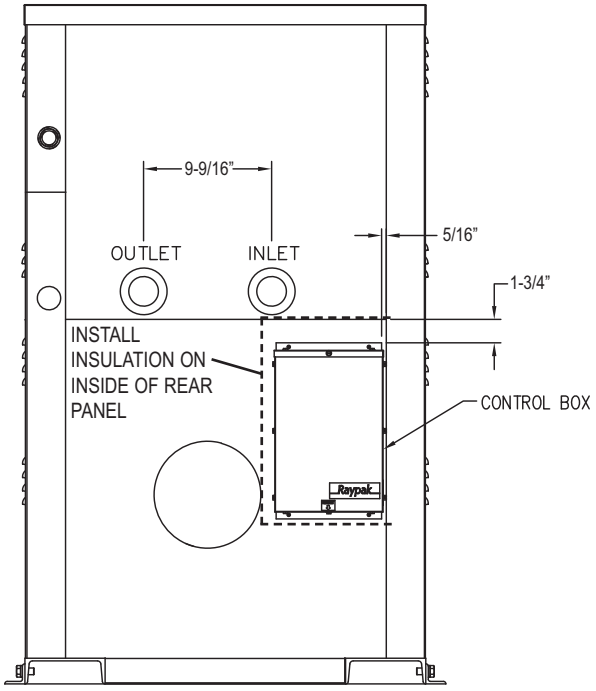
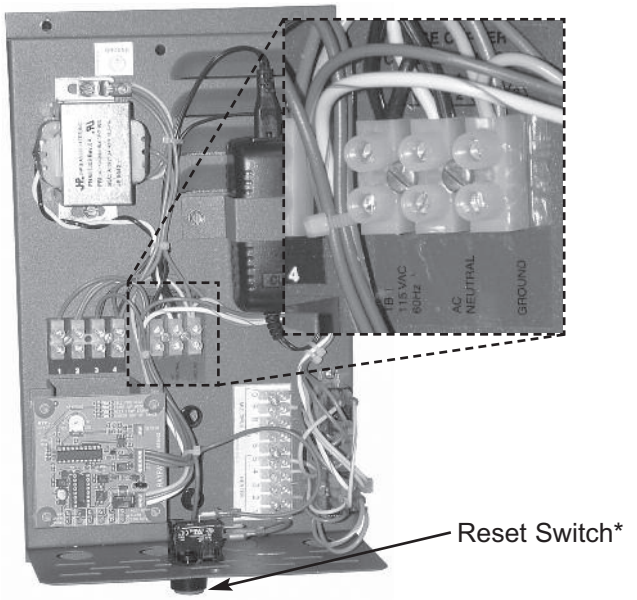


Fig. 8: Component Locations—MVB

CAUTION: Install the foil-faced insulation on the inside of the rear panel of MVB heaters as indicated in Fig. 8. Use spray adhesive or high temp foil tape to attach the insulation. Ensure that the foil faces the heat exchanger assembly. Failure to install this insulation as directed can cause overheating of the components and may void the warranty on the control.



*The reset switch may be located on the front control panel on some MVB models.

Fig. 9: Location of TB1 in Control Box

Connecting Power to the Controller

Connect power from the 120 VAC power input of the heater to the controller power inputs Terminal Block (TB1). This is accomplished by connecting wiring from the control box to the heater 120 VAC power input connections. Refer to the heater wiring diagrams.

Connecting Boiler to Cold Water Start

The installer must provide five 18AWG stranded wires between the heater and the controller terminal block. Wiring is to be run in separate conduit from line voltage to ensure proper operation. Refer to the diagrams on page 17 for connection points depending on the Raypak product being used.

Operation

Verify the following upon a CALL FOR HEAT signal from the heater:

1. CALL FOR HEAT: LED on PCB illuminates GREEN.

2. START UP MODE: LED on PCB illuminates YELLOW. It should go out in less than 7 minutes, as the boiler inlet temperature approaches the setpoint temperature.

3. The “ACTUATOR” should be in the fully open position or move to the fully open position if not already there. (Actuator and ball rotated to the at-rest CCW position).

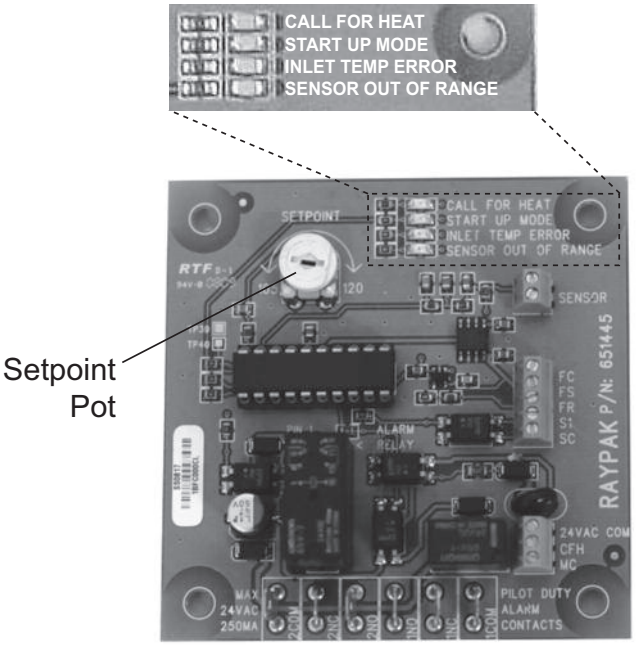


Fig. 10: Control PCB

4. If the control is operating properly, the "START UP MODE" LED should go out in less than 7 minutes. At this point, the inlet water temperature should be stable at a temperature between 105°F and 120°F corresponding to the Setpoint Pot setting on the PCB. The actuator should have stopped moving.

NOTE: The minimum inlet water temperature to the heater to prevent condensate is 105°F on heaters with an efficiency of 85% or less, and 120°F on 87% efficiency heaters. Ensure that during operation the Setpoint Pot is adjusted properly.

NOTE: If a "DIP" switch is provided on the control PCB, verify that the switch settings are: 1 = OFF, 2 = ON, 3 = OFF.

Cold Start Sequence of Operation

1. 120VAC to heater sends 120VAC to Cold Start control on terminal block 1.

2. 120/24VAC transformer and 120VAC-12VDC converter are powered.

3. 120/24VAC transformer outputs 24VAC to pin 2 of terminal block 2

4. 24VAC leaves pin 2 of terminal block 2 and goes to the modulating three-way valve on the 20-30VAC lead, and to the NO contacts of the SPST relay located in the cold start control panel.

5. 120VAC-12VDC converter outputs 12VDC to the common terminal of the reset switch, located on the bottom of the cold start control panel.

6. The 12VDC signal crosses over the reset switch and goes to Terminal FS on the cold start circuit board.

7. Cold start control is now in standby until a Call for Heat occurs at heater.

8. The heater outputs 24VAC to terminal 4 of terminal block 3 located in Cold Start controller to indicate a CFH from the heater.

9. Terminal 4 of TB 3 sends 24VAC to the coil of the SPST relay located in the cold start control panel.

10. The SPST relay coil is energized and closes the contacts allowing 24VAC to energize the CFH terminal on the cold start circuit board.
    a) A two second delay occurs from the CFH signal to the output of power from terminal MC of the cold start circuit board.

11. 24 VAC is sent from terminal 2 of terminal block 3 to the NO contacts of the DPST relay located in the cold start control panel.

12. After the two second delay on the cold start circuit board, pin MC outputs a 24 VAC signal to the coil of the DPST relay located in the cold start control panel.

13. The DPST relay coil energizes and closes the NO contacts.

14. Once the NO contacts of the DPST close, the heater 24 VAC is sent back to the heater to complete the circuit (pin 3 of terminal block 3) and the interlock circuit (pin 1 & 2 of terminal block 3) allowing the heater to fire.

15. Pin FR on the TVC board outputs 10VDC to the modulating three-way valve actuator to drive it fully open for two minutes waiting for the heater to reach full fire.

16. After the two-minute delay the 10VDC output signal from pin FR reduces to approximately 8VDC.

17. The output signal continues to vary depending on the heater inlet temperature.

NOTE: The heater will lockout and shut down if the setpoint on the inlet temperature is not achieved within seven minutes from a call for heat.

The DIP switches on the three-way valve actuator must be set as indicated in the Fig. 11 below:

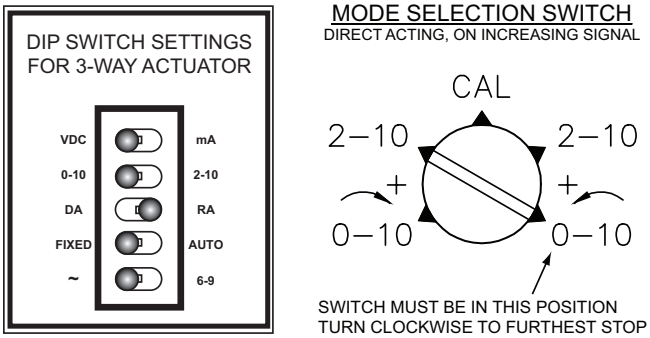


Fig. 11: Set Dip Switch Settings — Delta Actuator

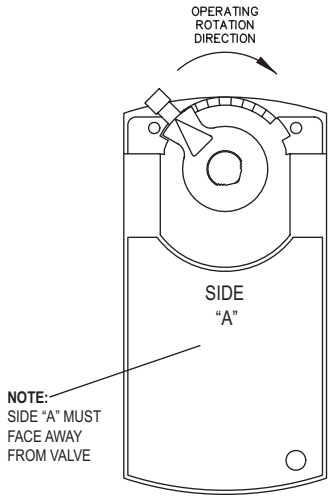


Fig. 12: Delta Actuator — Actuator Shown in Full System Flow Position

CAUTION: Delta actuator requires the use of the factory-supplied weatherproof cover for outdoor installations.

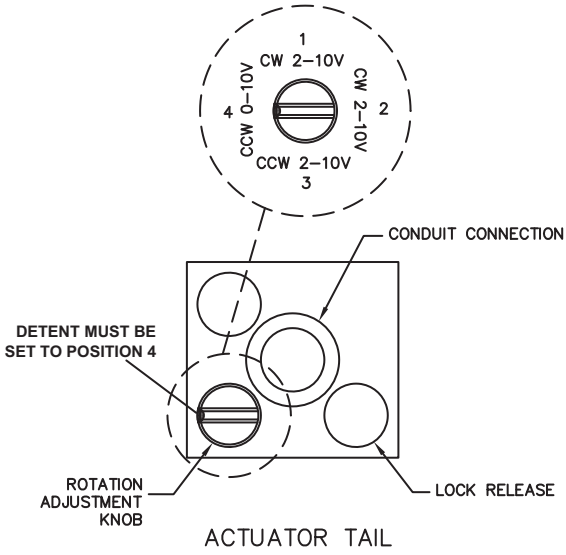


Fig. 13: Elodrive Actuator — Rotation Knob Setting Set adjustment knob to Position 4

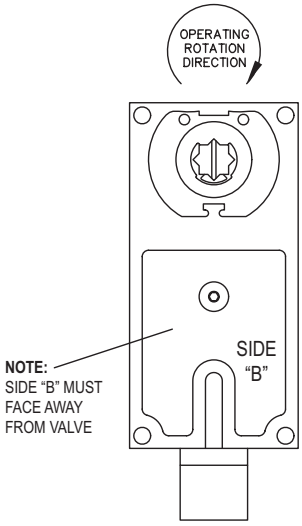


Fig. 14: Elodrive Actuator — Actuator Shown in Full System Flow Position

NOTE: The Elodrive actuator is NEMA 4 rated. No outdoor cover is required.

Troubleshooting

Check your power source using a Volt-Ohm meter; check the following voltages at TB1 terminal block:

TB1-1 to TB1-2 = 108 VAC Minimum, 132 VAC Maximum

TB1-1 to TB1-3 = 108 VAC Minimum, 132 VAC Maximum

TB1-2 to TB1-3 = Must be less than .6 VAC

IF CALL FOR HEAT LED does not illuminate when the heater has a CFH signal, check for 24VAC between pins 4 and 5 of TB3 on the cold start control. If voltage is present, check wiring using the wiring diagram. If voltage is not present, the problem exists in the heater.

IF VALVE DOES NOT MOVE: Check for voltage out at TB2-1: Should be a 1VDC to 10VDC output to the actuator valve. If no voltage is present, check for voltage at pin FS on the control board, there should be a 12VDC signal. If the 12VDC signal is not present, verify that the converter is wired correctly using the wiring diagram.

IF INLET TEMP ERROR is illuminated: The setpoint temperature has not been reached within the 7 minute time period.

- Push the Reset Switch (see Fig. 9) or remove power and watch for proper operation.

- Check pump sizing and valve/piping sizing and correct as necessary.

IF SENSOR OUT OF RANGE LED is illuminated: The sensor may have a short or open circuit.

- Press and release the Reset Switch (see Fig. 9) and watch for proper operation.
- Replace sensor.
- Check wiring using wiring diagram.

Mounting the Actuator to the Valve

When mounting the actuator to the valve, ensure that the valve stem is oriented with the machined flat notch positioned parallel to the “A” and “AB” ports as shown in Fig. 15.

All actuators used by Raypak include the “spring return” safety feature. This means that upon loss of power during operation the valve automatically rotates back to the full system flow position avoiding high limit lockouts or other issues.

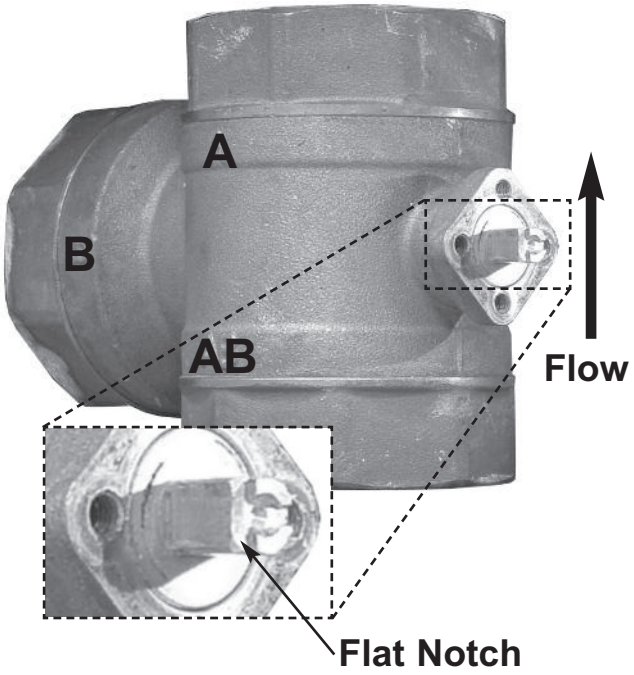


Fig. 15: Orient Notch Parallel with “A” and “AB” Ports

Mounting Brackets (Elodrive)

There are different actuator mounting brackets on the three-way valves. When ordering a replacement bracket you will receive the newest design available from the manufacturer. If it appears to be different than the damaged bracket, the new and old are interchangeable and will fit all valve bodies. See Fig. 16.

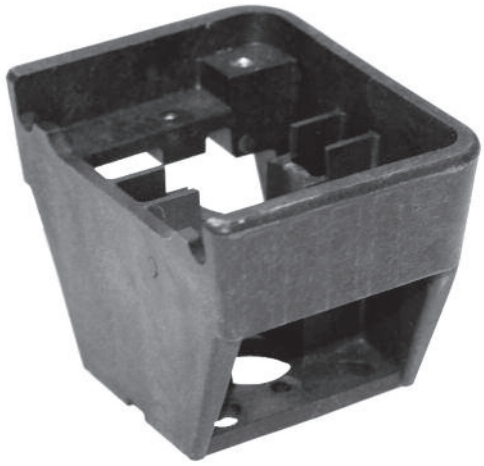


Fig. 16: Elodrive Mounting Bracket

Locating the Rotation Stop (Elodrive)

An internal rotation stop device is built into the actuator mounting bracket and this can be installed only two ways for proper operation of the valve. The stop is labeled on each side with either “D” or “P”. This indicates that the valve is set up for either a diverting application or proportional (mixing) application. Raypak uses the three-way valve in a mixing application therefore the “P” designator must be facing away from the bracket.

The valve rotates in a clockwise direction when it is operating. The rotational stop must be positioned so that the drive linkage can rotate. The drive linkage is keyed to allow only 90 degrees of rotation. Ensure that the key is positioned so the linkage may rotate clockwise as shown in Fig. 17.

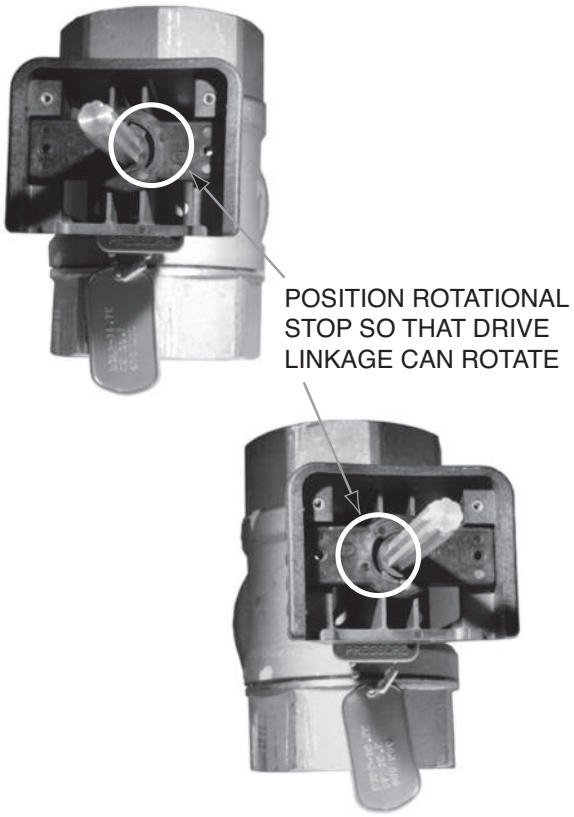


Fig. 17: Elodrive Rotational Stop Positioning

Drive Linkage (Elodrive)

The drive linkage for the 2" NPT and 2-1/2" NPT three-way valves originally were supplied with an orientation groove in the end of the stem. This groove has now been removed by the vendor. All new linkage stems will have a smooth end. Using the groove to determine ball position inside of the valve is not reliable and should be avoided.

Verifying Ball Position

All field-installed valves must have the ball properly positioned. Occasionally differences occur from the manufacturer of the valve body. The square stem that the drive linkage attaches to should have a machined notch to verify ball position, however on occasion it is not there. To properly orient the ball follow these instructions **PRIOR** to installation into your plumbing system.

- Remove the actuator and base from the valve body.
- With port "AB" facing you, rotate the valve stem approximately 45 degrees clockwise. You must see two port openings if the ball is correctly oriented.
- If you do not see two openings at this point, continue rotating the stem and ball until you do.
- Once you can see two openings, **STOP**, as shown in Fig. 18. Then rotate the stem counterclockwise until only one opening remains e.g. you can see completely through the valve (through ports A and AB).

Now the ball is correctly oriented inside of the valve body. Reassemble the valve, base and actuator, and then install the assembly into your piping system as indicated in this manual.

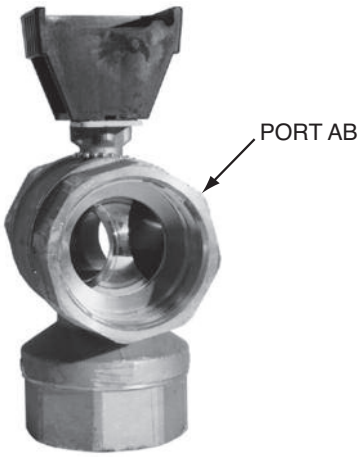


Fig. 18: Verifying Ball Position

Actuator to Valve Orientation

Install the actuator so that the tail is pointing downward as shown in Fig. 19. You may also install it horizontally, however, DO NOT mount it so that the tail is pointing up as shown in Fig. 20. Doing so will allow water and debris to collect in the cup where the wiring exits the actuator, potentially causing damage.

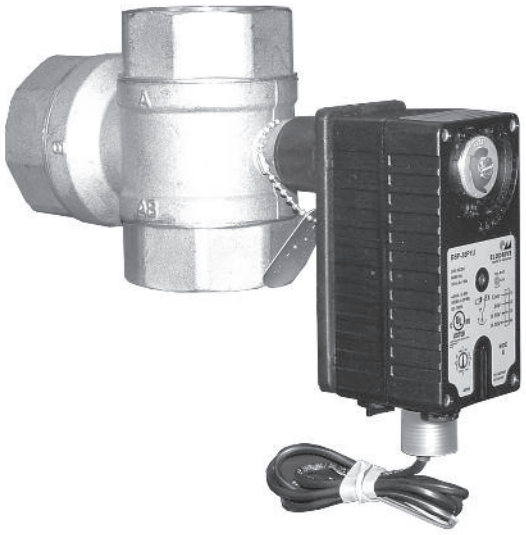


Fig. 19: Recommended Orientation of Actuator

Fig. 20: Incorrect Orientation of Actuator

Installing the Three-Way Valve

When threading any pipe into the ports of the three-way valve, a backing wrench MUST be employed. You must capture the valve body with a secondary wrench to avoid damaging the internal seals. Valve bodies leaking from improper installation are non-warrantable.

High Pressure Tab

Located between the valve body and the actuator mounting bracket, is a yellow tab labeled “High Pressure” see Fig. 21. This is for maintenance of the valve only.

If the valve stem begins leaking beneath the yellow tab the internal packing material must be replaced. The “High Pressure” tab is held on with two screws located under the mounting bracket.

To replace the packing material, all water pressure must be removed from the valve assembly and the assembly must be isolated from the system water. Then remove the actuator and bracket, then remove the two screws holding the “High Pressure” tab in place.

At this point the packing material can be removed and replaced just like any other valve assembly. The packing material is not available from Raypak.

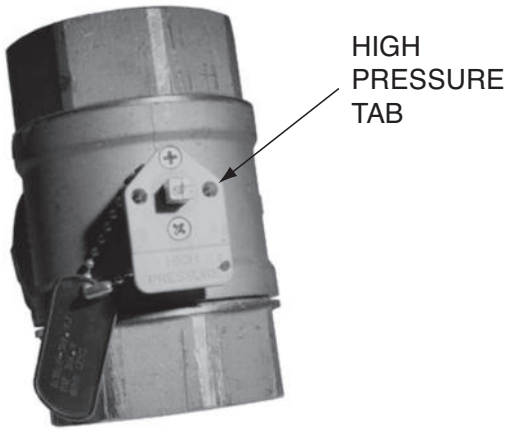


Fig. 21: High Pressure Tab

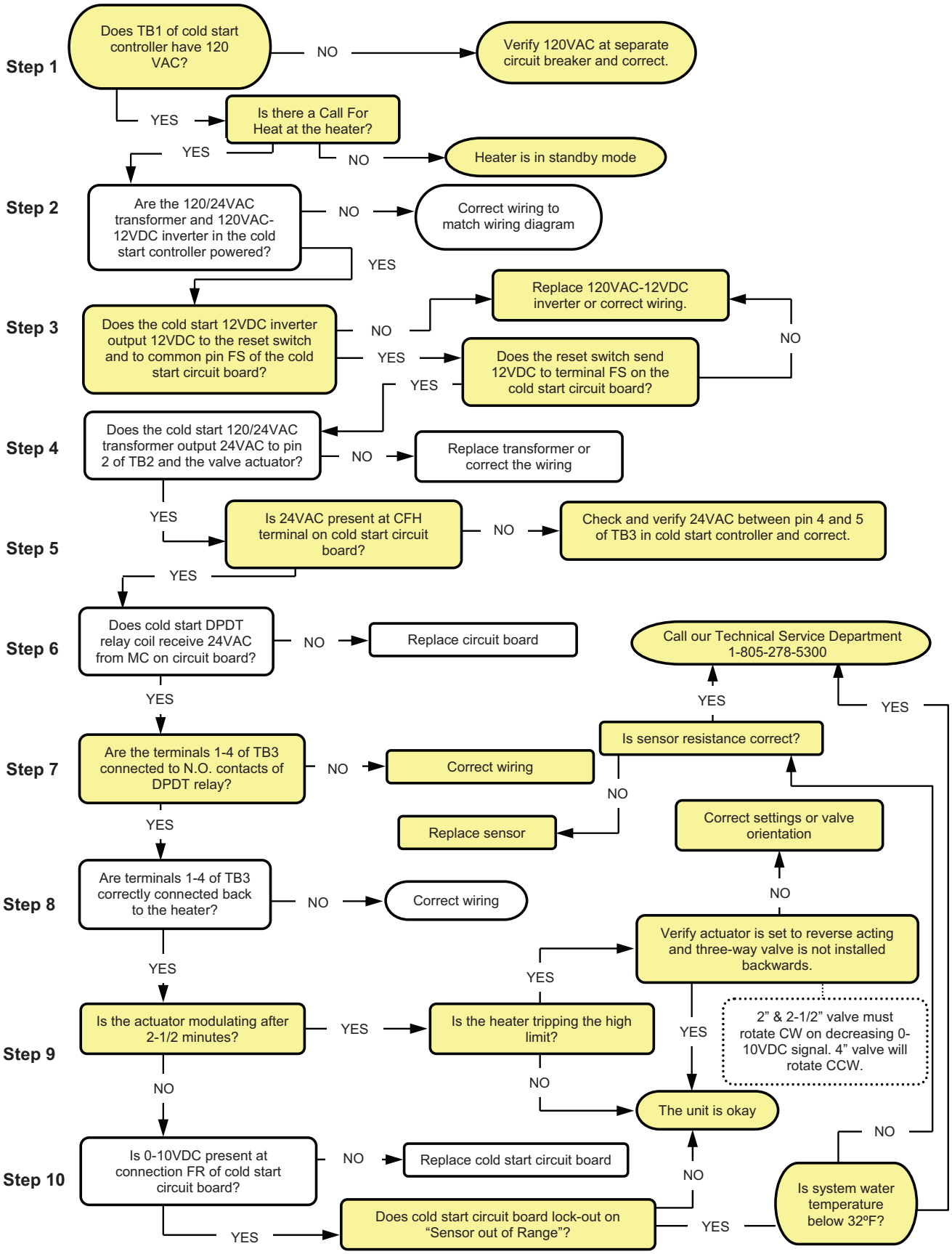
Actuator

The ELODRIVE actuator has a manual override for the valve. The label located over the silver colored primary label states, “Please read manual before using manual override”. Using the Allen wrench supplied with the loose valve, place it in the hexagonal opening under the label. See Fig. 22.

By pressing the red release button on the tail of the actuator and simultaneously rotating the Allen wrench you can rotate the ball clockwise. Once you release or remove the Allen wrench the ball will return to its original position by way of the “spring return”. This is an easy way to determine if the ball is oriented properly inside of the valve.

Fig. 22: Actuator

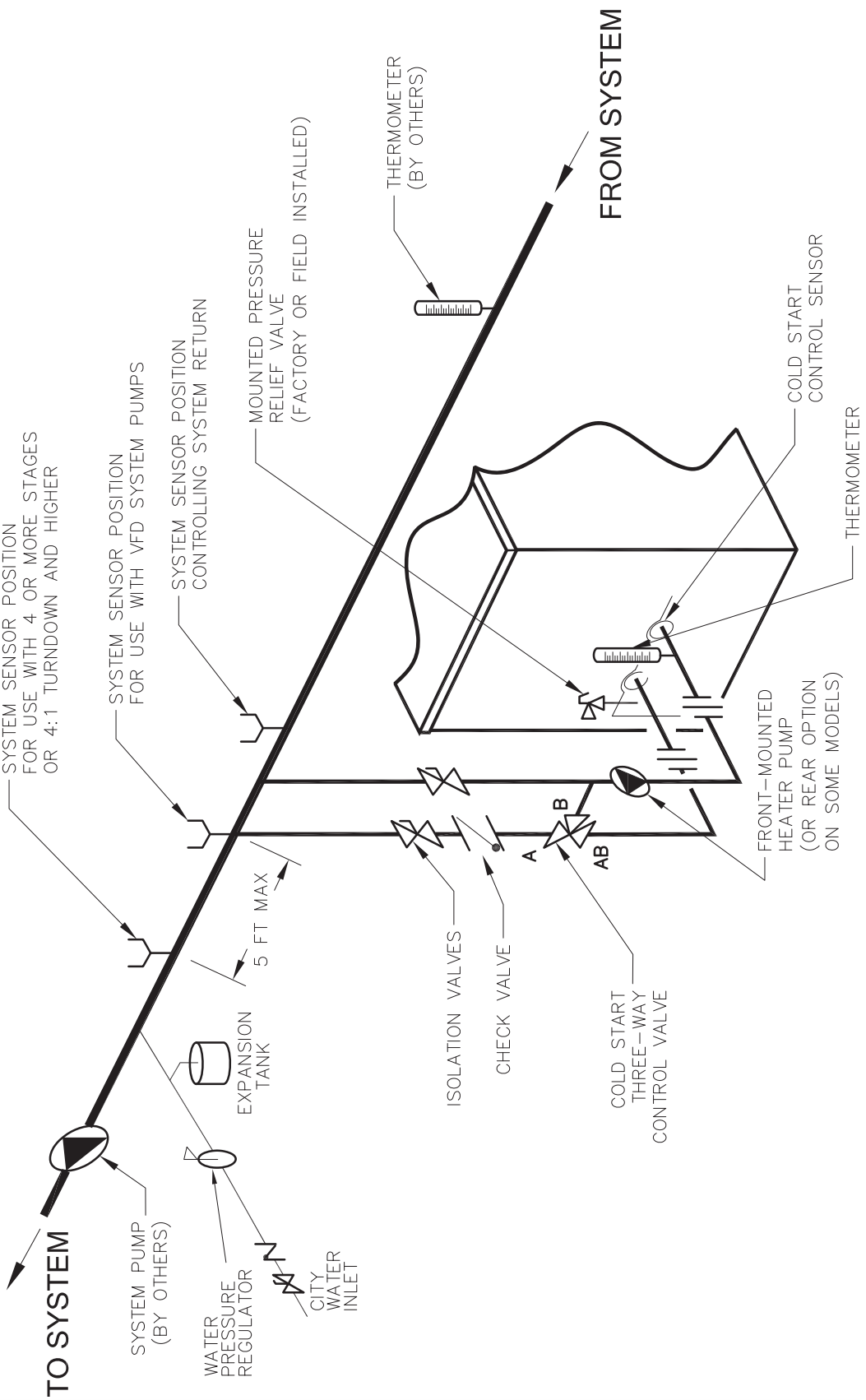
Cold Water Start Troubleshooting Guide


Step 1
Does TB1 of cold start controller have 120 VAC?
NO
Verify 120VAC at separate circuit breaker and correct.
YES
Is there a Call For Heat at the heater?
YES
NO
Heater is in standby mode
Step 2
Are the 120/24VAC transformer and 120VAC-12VDC inverter in the cold start controller powered?
NO
Correct wiring to match wiring diagram
YES
Step 3
Does the cold start 12VDC inverter output 12VDC to the reset switch and to common pin FS of the cold start circuit board?
NO
Replace 120VAC-12VDC inverter or correct wiring.
YES
Does the reset switch send 12VDC to terminal FS on the cold start circuit board?
NO
YES
Step 4
Does the cold start 120/24VAC transformer output 24VAC to pin 2 of TB2 and the valve actuator?
NO
Replace transformer or correct the wiring
YES
Step 5
Is 24VAC present at CFH terminal on cold start circuit board?
NO
Check and verify 24VAC between pin 4 and 5 of TB3 in cold start controller and correct.
YES
Step 6
Does cold start DPDT relay coil receive 24VAC from MC on circuit board?
NO
Replace circuit board
YES
Call our Technical Service Department 1-805-278-5300
YES
YES
Step 7
Are the terminals 1-4 of TB3 connected to N.O. contacts of DPDT relay?
NO
Correct wiring
Is sensor resistance correct?
NO
YES
Replace sensor
Correct settings or valve orientation
NO
Step 8
Are terminals 1-4 of TB3 correctly connected back to the heater?
NO
Correct wiring
YES
Verify actuator is set to reverse acting and three-way valve is not installed backwards.
YES
Step 9
Is the actuator modulating after 2-1/2 minutes?
YES
Is the heater tripping the high limit?
YES
2” & 2-1/2” valve must rotate CW on decreasing 0-10VDC signal. 4” valve will rotate CCW.
NO
NO
The unit is okay
Step 10
Is 0-10VDC present at connection FR of cold start circuit board?
NO
Replace cold start circuit board
NO
Is system water temperature below 32ºF?
NO
YES
Does cold start circuit board lock-out on “Sensor out of Range”?
YES

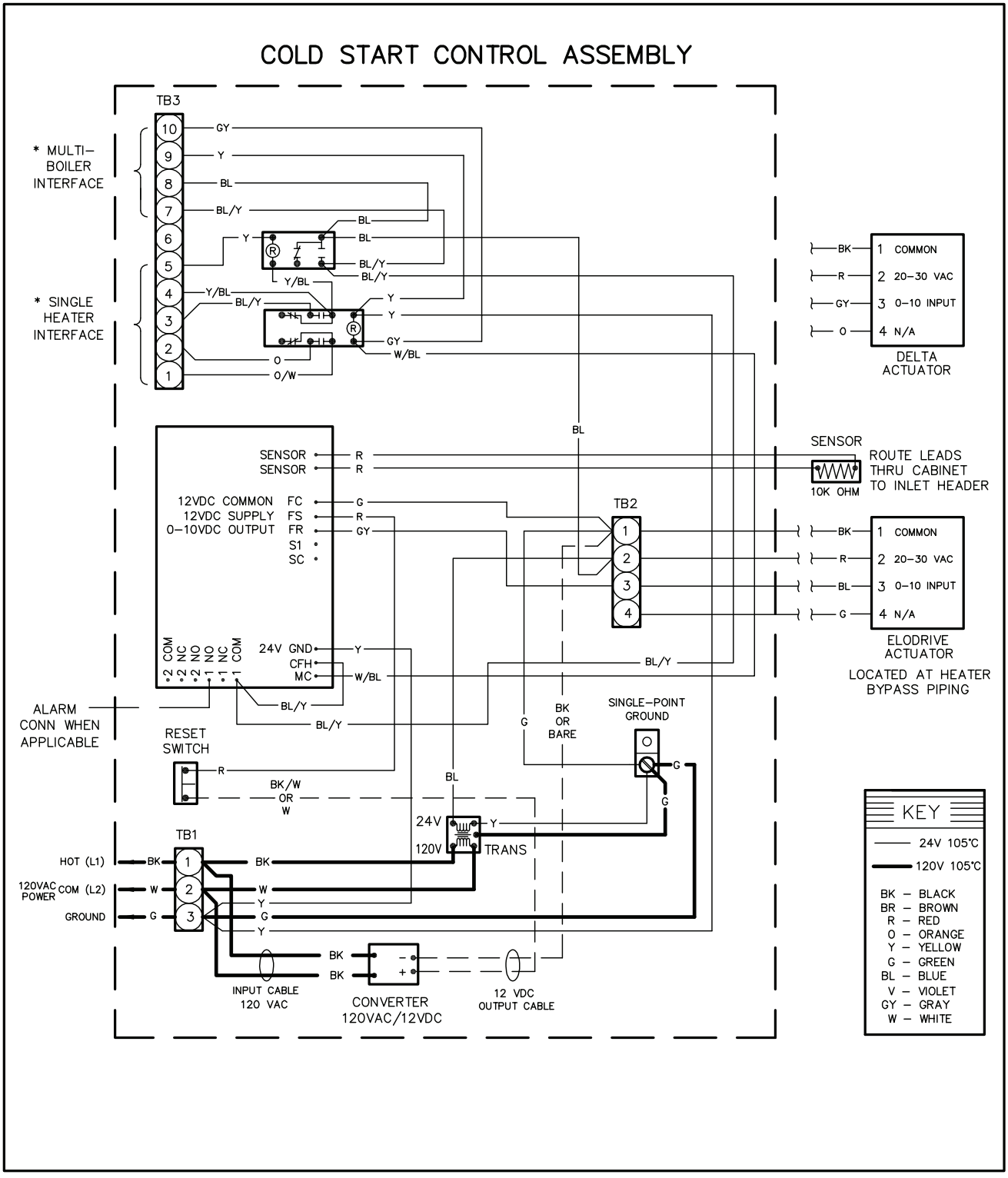
Typical Cold Water Start Piping

NOTES:

1. LOCATE UNIONS TO FACILITATE SERVICING OF PLUMBING SIDE.
2. PLUMB SWING CHECK VALVE IN GRAVITY-CLOSED POSITION.
3. PIPE ALL RELIEF VALVES TO DRAIN, OR AS LOCAL CODES REQUIRE.
4. BUFFER TANK REQUIRED WHEN WATER VOLUME IN BOILER LOOP IS NOT ADEQUATE TO PROVIDE STABLE TEMPERATURE CONTROL. CONSULT FACTORY FOR TANK SIZING.
5. SYSTEM FLOW MUST EXCEED HEATER FLOW AT ALL TIMES.

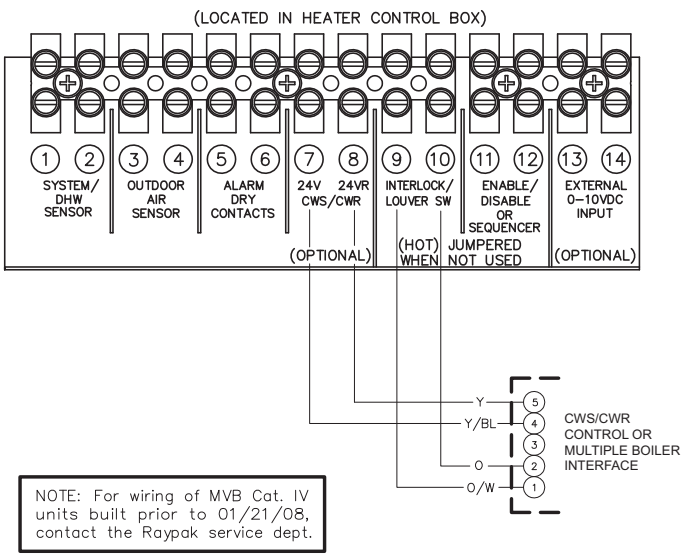

TO SYSTEM
FROM SYSTEM
SYSTEM PUMP (BY OTHERS)
WATER PRESSURE REGULATOR
CITY WATER INLET
EXPANSION TANK
5 FT MAX
SYSTEM SENSOR POSITION FOR USE WITH 4 OR MORE STAGES OR 4:1 TURNDOWN AND HIGHER
SYSTEM SENSOR POSITION FOR USE WITH VFD SYSTEM PUMPS
SYSTEM SENSOR POSITION CONTROLLING SYSTEM RETURN
MOUNTED PRESSURE RELIEF VALVE (FACTORY OR FIELD INSTALLED)
THERMOMETER (BY OTHERS)
ISOLATION VALVES
CHECK VALVE
COLD START THREE-WAY CONTROL VALVE
A
B
AB
FRONT-MOUNTED HEATER PUMP (OR REAR OPTION ON SOME MODELS)
COLD START CONTROL SENSOR
THERMOMETER

Wiring Diagrams—Cold Water Start



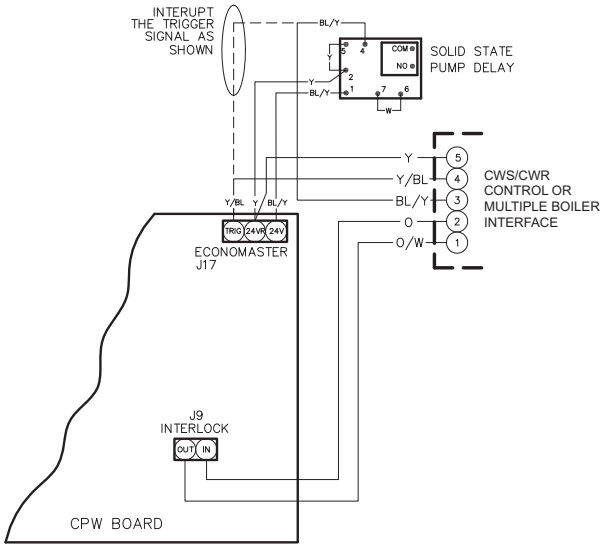
HEATER INTERFACE WIRING FOR CWS OR CWR

MVB (503–2004)



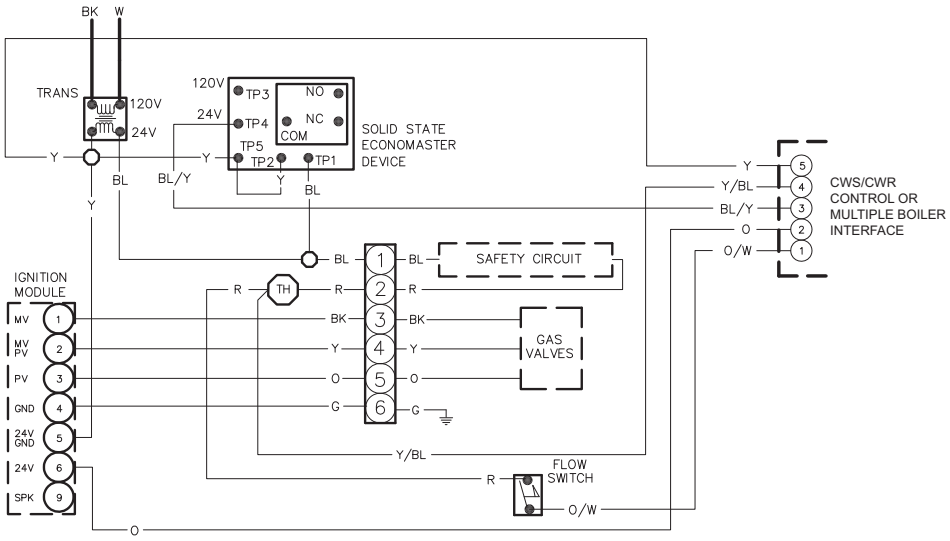
NOTE: For wiring of MVB Cat. IV units built prior to 01/21/08, contact the Raypak service dept.

HI DELTA (302–2342)



RAYTHERM

(SOME COMPONENTS REMOVED FOR CLARITY)



COLD WATER START—MULTIPLE HEATER
(Maximum 4 heaters)

Materials Included

1 Cold Start Control Box
1 Multi-Boiler Interlock Box
1 Water Sensor & Well
1 Three-way Diverting Valve assembly with Actuator

NOTE: Flanges, bolts and gaskets for flanged valves supplied by others.

Installation

Mounting the Control Boxes

Cold Start Control and Multi-Boiler Interlock should be mounted in such a manner as to allow for easy access for wiring of the boiler interlock connections.

Installing the Temperature Sensor

Temperature sensor to be installed in a drywell with thermal paste at the location indicated in the diagram on page 21 to ensure proper operation of the control system. Installer must ensure the drywell extends at least 2 inches into the water flow path. Sensor wiring must be run in separate conduit from line voltage and should be a minimum of 18 AWG shielded cable. Refer to diagram on page 22 for wiring information.

Installing the Three-way Valve

Install three-way diverting valve into common boiler piping manifold as shown in the diagram on page 18. Boiler common outlets to be connected at port AB. Discharge to system from port A with bypass port being port B. Common pipe sizing may be larger than three-way valve port connections requiring the use of increasers for installation (see Table B for valve sizing). It is recommended that three-way valve be installed as near the main system piping as is feasible. Route control wiring in separate conduit to the Cold Water Start control box and wire as shown in the diagram on page 19.

Connecting Power to the Controller

Installer to provide a dedicated 120V circuit with local disconnect to the Cold Water Start Control. Refer to wiring Fig. 9 on page 8 for detailed instruction.

Connecting Cold Water Start to Multi-Heater Interlock Box

Installer to provide four 18AWG stranded wires between pins 7-10 on the Cold Start Control and 7-10 on the Multi-Boiler Interlock as shown in the diagram on page 22. Do not use solid core wire when wiring any portion of the Cold Start Multi-Boiler system.

Connecting Heater to Cold Water Start Multi-Heater Interlock

Installer to provide five 18AWG stranded wires between each boiler and Multi-Boiler Interlock box. Wiring to be run in separate conduit from line voltage to ensure proper operation. Refer to the diagram on page 22 for connection points depending on Raypak product being used.

Total Load (MBTU)	Valve Size	Minimum Pipe Size	Cv	Flow Rate (gpm)	Valve Pressure Drop	ΔT @ Max Size	ΔT @ Min. Size	Order No.
600-1000	2” NPT	2	57	70	3.5 ft	22	14.4	012228
1001-1800	2.5” NPT	2.5	74	100	4.2 ft	30.2	16.8	012229
1801-2600	2.5” NPT	3	100	150	5.2 ft	29.1	20.1	012230
2601-4000	4” FLG*	4	152	220	4.8 ft	30.5	22.9	012231
4001-6000	4” FLG*	4	254	330	3.9 ft	30.5	20.3	012232
6001-8000	4” FLG*	6	327	440	4.2 ft	30.5	22.5	012233

Standard boiler pump options offered by Raypak may **NOT** be appropriate for these applications.
***CAUTION:** Approved for closed loop systems only.

Table B: Valve Sizing Chart

Actuator to Valve Orientation

Install the actuator so that the tail is pointing horizontally as shown in Fig. 26 or is pointing down. DO NOT mount it so that the tail is pointing up as shown in Fig. 20. Doing so will allow water and debris to collect in the cup where the wiring exits the actuator, potentially causing damage.

Three-Way Valve Ball Orientation

The ball orientation must be verified prior to mounting the flanged valve into the piping system. With the flanged four-inch valve it is a fairly simple procedure. Do not use the groove on the end of the drive linkage to verify.

First, remove the actuator by removing the wing-nut underneath the mount bracket near the tail. Second, loosen the locking bolt on top of the actuator that clamps to the drive linkage. See Fig. 23.

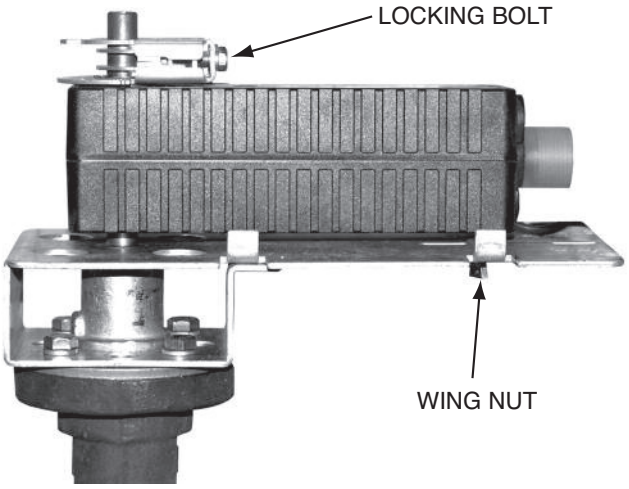


Fig. 23: Removing the Actuator (Elodrive)

Once this has been done, remove the actuator by lifting straight off the drive linkage shaft.

Now the ball position must be verified. Using pliers, grasp the base of the drive linkage. While looking into port AB, rotate the drive linkage counterclockwise about 45 degrees. See Fig. 24. You should see two partial openings similar to Fig. 18.

If you do not see the two partial openings after 45 degrees of rotation, continue rotating until you do. Once you see the two partial openings, STOP. Now rotate the shaft in the reverse direction (clockwise) until you can see straight through to valve from port AB to port A.

Reinstall the actuator and bracket assembly in reverse order, and ensure that the ball assembly is properly oriented. Mount the flanged valve into your piping system in accordance with this manual.

Valve Installation

To properly install this valve port “AB” must be connected to the combined outlet of the heater(s); and port “B” must be attached to the bypass between the combined inlet and the combined outlet, as shown on page 21. The valve body has the port designators cast into the drive linkage housing. See Fig. 25.

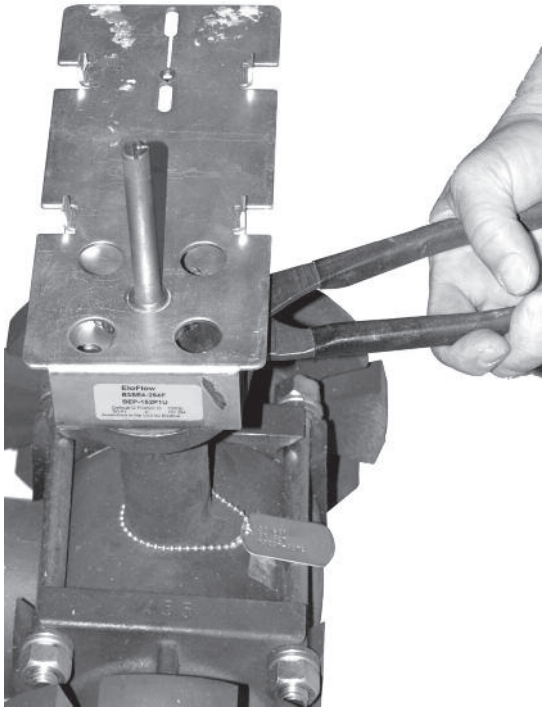


Fig. 24: Rotating the Drive Linkage

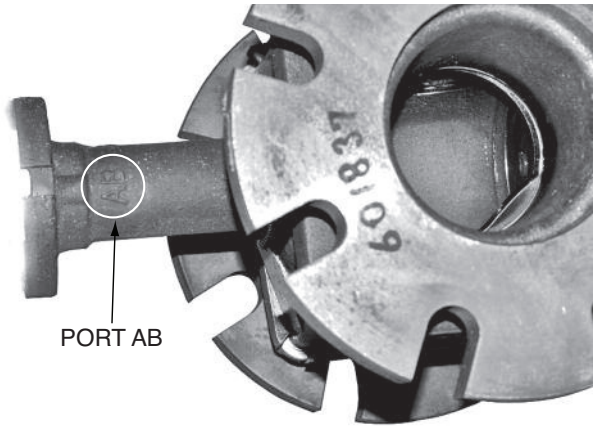


Fig. 25: Valve Orientation

4-Inch Valve Orientation

The valve must be installed so that the combined boiler outlets enter through Port "AB" (See Fig. 26). Port "B" is the bypass port and port "A" is the return to the system (port designations are cast into the stem of the valve body). The valve body should be installed so that the actuator input shaft is in the vertical or horizontal position. The Actuator stem should never be hanging downward.

The actuator, as shipped from the factory, is in the horizontal position when the valve is installed as shown in Fig. 26. The actuator position can be changed to suit job site conditions.

Under no circumstances should the actuator be positioned such that the electrical connection is pointing upwards (see Fig. 20) as this can allow for moisture or debris to enter the actuator assembly and potentially damage the actuator.

Before installing into the piping system, verify the valve is positioned properly by referring to Fig. 26 and the diagram on page 21.

Connecting the Actuator

The 4-inch valve is shipped loose, and must be field wired. Connect the actuator leads to the Cold Water Start control panel, as indicated in the wiring diagram on Page 16.

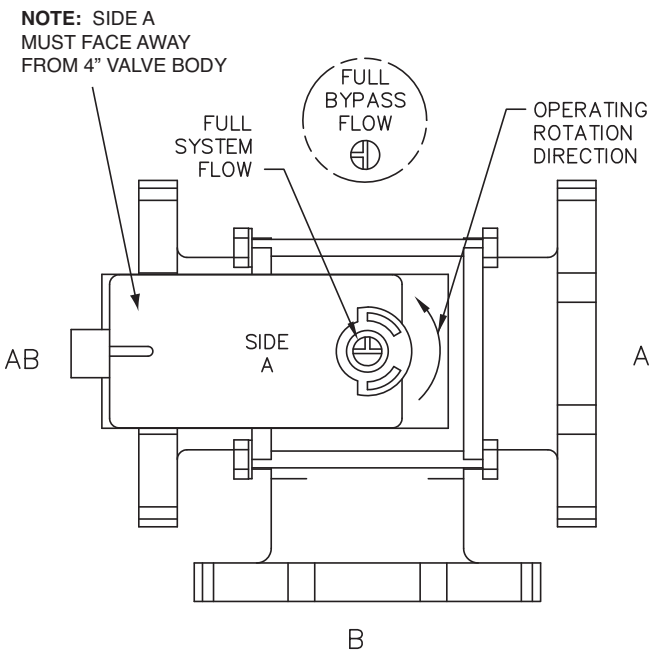


Fig. 26: Valve Orientation (Elodrive Actuator)

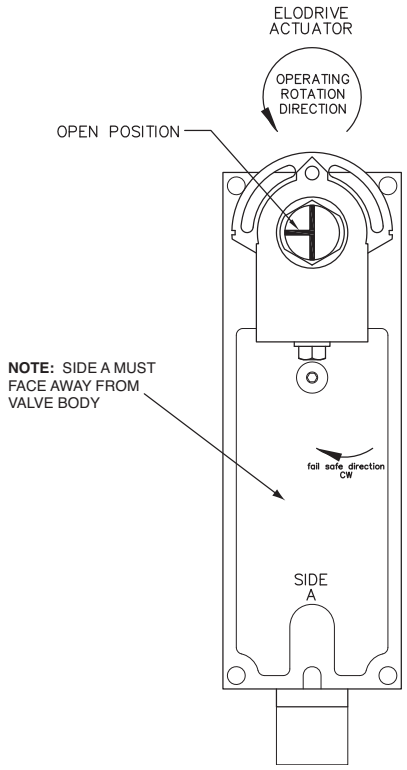


Fig. 27: Elodrive actuator used on 4" valves (Actuator shown in full system flow position.)

The actuator for the 4" valves rotates opposite to the direction of the smaller actuators. On an Elodrive actuator, Side A must be facing away from the valve.

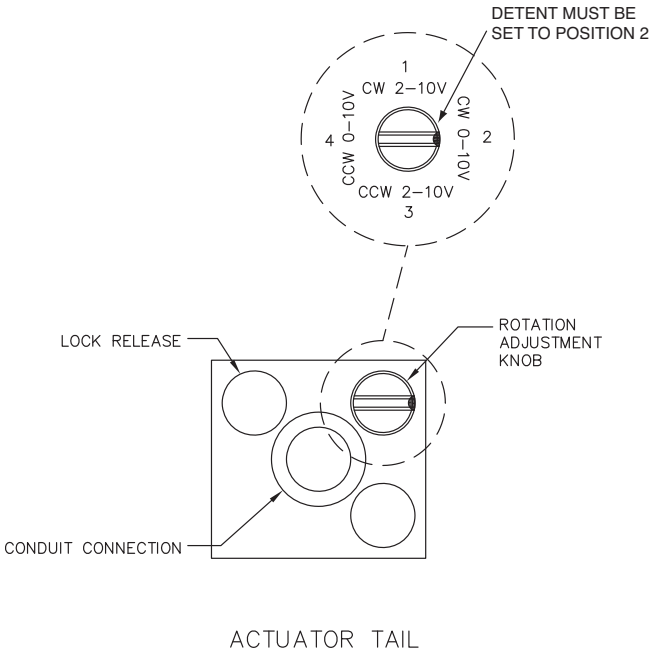
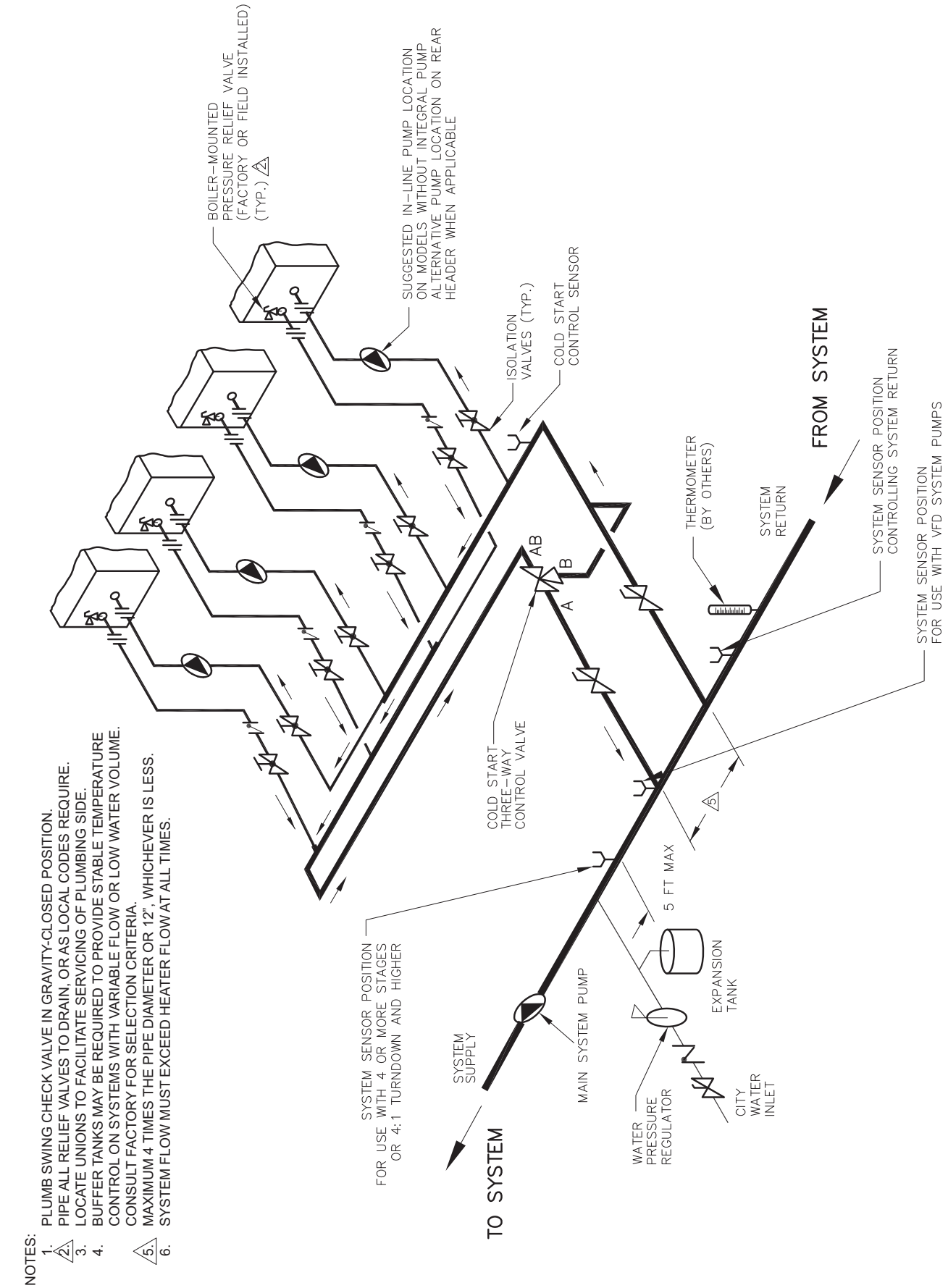


Fig. 28: Rotational Setting for Elodrive Actuator Used on 4" Valves

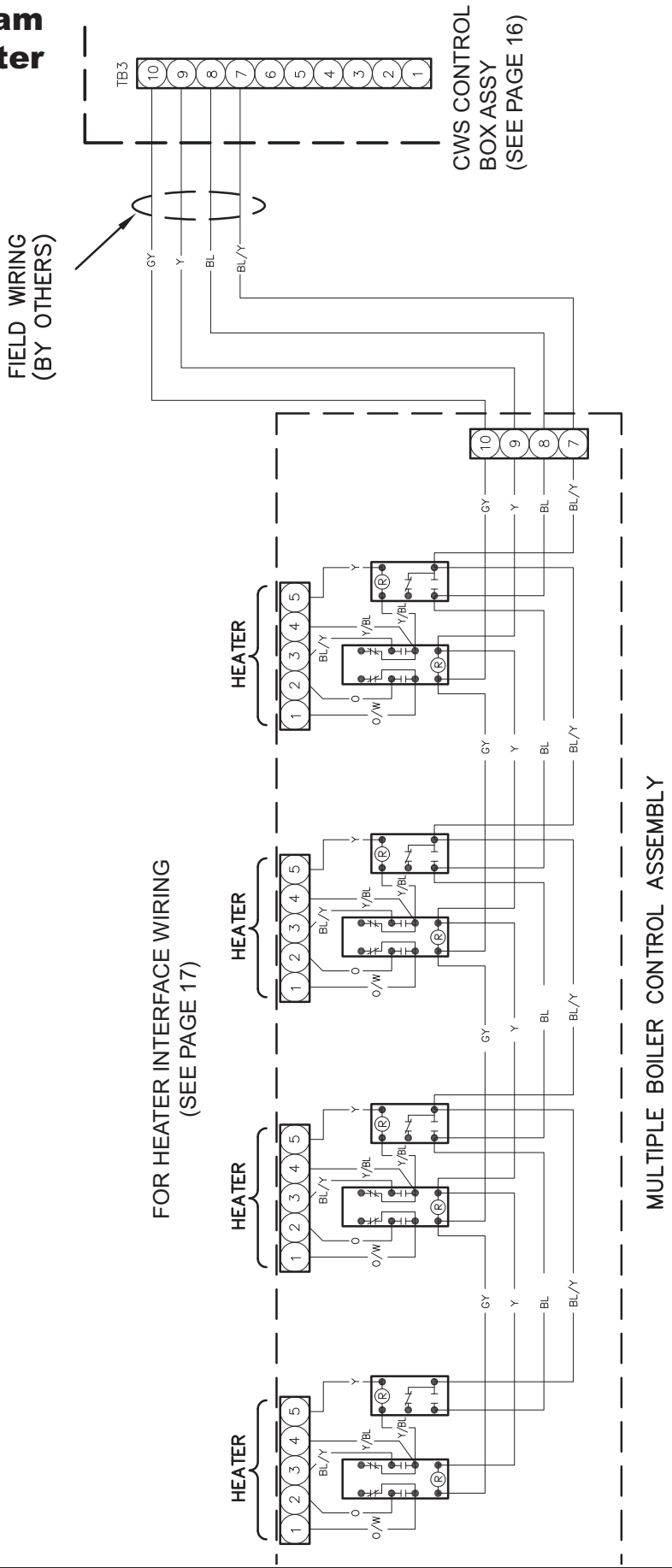
Typical Cold Water Start Multiple Heater Piping



NOTES:

1. PLUMB SWING CHECK VALVE IN GRAVITY-CLOSED POSITION.
2. PIPE ALL RELIEF VALVES TO DRAIN, OR AS LOCAL CODES REQUIRE.
3. LOCATE UNIONS TO FACILITATE SERVICING OF PLUMBING SIDE.
4. BUFFER TANKS MAY BE REQUIRED TO PROVIDE STABLE TEMPERATURE CONTROL ON SYSTEMS WITH VARIABLE FLOW OR LOW WATER VOLUME. CONSULT FACTORY FOR SELECTION CRITERIA.
5. MAXIMUM 4 TIMES THE PIPE DIAMETER OR 12", WHICHEVER IS LESS.
6. SYSTEM FLOW MUST EXCEED HEATER FLOW AT ALL TIMES.

Wiring Diagram
Multiple Heater



COLD WATER RUN

NOTE: After testing at the factory it may be prudent to ship the piping assembly disassembled and attached to the heater pallet. This is done to avoid shipping damage and it must be reassembled on the jobsite. Use Fig. 29 to assist you in reassembling the piping.

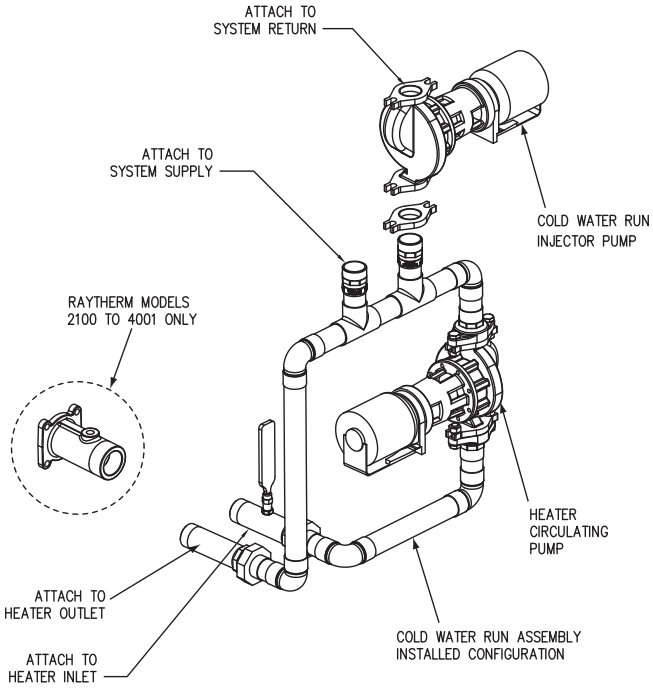


Fig. 29: Cold Water Run Assembly

Purpose

The Cold Water Run system utilizes a variable-speed pump to inject the proper amount of water from the main system loop into the heater to maintain the optimum inlet temperature. This approach allows the full capacity of the heater to be utilized to meet the system load, while at the same time continuously maintaining the optimum inlet water temperature to prevent condensation.

Typical Cold Water Run Applications

- Swimming pools.
- Any system with steady-state (or “consistent”) return water temperature below 105°F.

CWR vs. CWS

- Cold water start is for transient cold water operation.
- Cold water run is for continuous operation below 105°F system return temperature.
- Cold water start maintains design flow rate at system design temperature but reduces boiler flow rate during heavy bypass operation.
- Cold water run maintains constant design flow rate in the boiler.

Installation

Before beginning the installation, it's important to first inspect the system and determine what materials you will need. Some parts are included with the controller while others you will need to provide.

Installation Codes

Installations must be in accordance with local, state, provincial, and national codes, laws, regulations and ordinances. In the absence of local codes, installations must be in accordance with the latest editions of the:

- National Fuel Gas Code, ANSI Z223.1/NFPA 54
- National Electrical Code, ANSI/NFPA 70
- For Canada only: CAN/CSA B149 Installation Code and CSA C22.1 C.E.C. Part 1 and Part 2

Mounting the Control Box

NOTE: The heater should not be located in an area where possible water leakage will result in damage to the area adjacent to the heater or to the structure. When such locations cannot be avoided, it is recommended that a suitable drain pan, with adequate drainage, be installed under the heater. The pan must not restrict combustion air flow.

The control box should be mounted on the side of the heater to which the system piping and pump assemblies are to be attached as shown in Figs. 4–8 on pages 7 & 8. The controller should be mounted so as to provide maximum support by using the mounting holes provided on the base of the controller to the side center brace on the heater. You will need to drill mounting holes for #10 hardware and 3/4” conduit access holes through the heater side panel for the routing of wiring and the sensor.

CAUTION: Remote mounted controller must be installed within 25 feet of wire length to the heater.

Injector & Heater Pump Comparison

Heater Model	Heater Pump				Injector Pump		
	Flow	Temp. Rise	Press. Drop	Pump Model/Imp.	Flow	Temp. Rise	Pump Model-hp
302	32	16	2	112	13	40	1911-¼ hp
402	34	20	2	112	17	40	1911-¼ hp
502	42	20	2.3	1630/4.0	22	40	1911-¼ hp
652	55	20	4.1	1630/4.0	28	40	1911-¼ hp
752	63	20	5.7	1630/4.2	32	40	1911-¼ hp
902	76	20	8.4	1630/4.2	38	40	1911-¼ hp
992	83	20	5.2	1630/4.7	42	40	1911-¼ hp
1262	107	20	9.6	1630/4.7	54	40	1911-⅓hp
1532	120	22	12.4	1632/5.6	62	42	1911-⅓hp
1802	120	25	13	1632/5.6	68	45	1911-⅓hp
2002	132	26	19	1634/6.1	74	46	1935-¾hp
2072	132	27	19	1634/6.1	75	47	1935-¾hp
2342	132	30	21.4	1634/6.1	80	50	1935-¾hp

Table C: Injector and Heater Pump Specifications—Hi Delta

Heater Model	Heater Pump				Injector Pump		
	Flow	Temp. Rise	Press. Drop	Pump Model	Flow	Temp. Rise	Pump Model-hp
503	58	15	2.4	1611	29	30	1911-¼ hp
753	63	21	5.6	1611	44	30	1911-¼ hp
1003	87	20	8.2	1630	58	30	1911-⅓ hp
1253	86	25	12.2	1630	73	30	1911-⅓ hp
1503	100	26	18.5	1632	87	30	1911-⅓ hp
1753	109	28	26	1634	102	30	1911-⅓ hp
2003	116	30	36.2	1636	116	30	1935-¾ hp

Table D: Injector and Heater Pump Specifications—MVB

Heater Model	Heater Pump				Injector Pump		
	Flow	Temp. Rise	Press. Drop	Pump Model/Imp.	Flow	Temp. Rise	Pump Model-hp
926/962	79	20	8.5	1630/4.7	50	32	1911-¼ hp
1083/1125	90	21	12.0	1630/4.7	50	37	1911-¼ hp
1178/1223	90	22	12.5	1630/4.7	60	33	1911-⅓ hp
1287/1336	90	25	13.2	1630/4.7	60	37	1911-⅓ hp
1414/1468	90	27	14.0	1632/5.65	60	40	1911-⅓ hp
1571/1631	90	30	14.5	1632/5.65	60	45	1911-⅓ hp
1758/1826	90	34	15.4	1632/5.65	60	50	1911-⅓ hp
2100	172	20	11.0	1641/6.9	130	26	1935-¾hp
2500	200	21	15.8	1641/6.9	130	32	1935-¾hp
3001	200	25	16.7	1641/6.9	130	38	1935-¾hp
3500	200	29	17.5	1641/6.9	130	44	1935-¾hp
4001	200	33	18.7	1641/6.9	130	50	1935-¾hp

Table E: Injector and Heater Pump Specifications—Raytherm

Check the Power Source

WARNING: Using a multi-meter, check the following voltages at the circuit breaker panel prior to connecting any equipment. Make sure proper polarity is followed and house ground is proven.

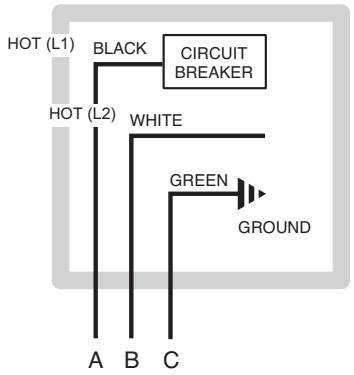


Fig. 30: Wiring Connections

Check the power source:

AC = 104 VAC Minimum, 126 VAC MAX
AB = 208 VAC Minimum, 252 VAC MAX
BC = 104 VAC Minimum, 126 VAC MAX

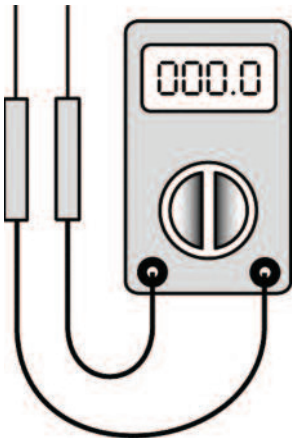


Fig. 31: Multi-meter

Injector Pump Wiring

The 3-phase cold water run pump is shipped loose and must be field wired.

Before Starting

1. Turn off power to the unit at the circuit breaker.
2. Turn off gas supply.
3. Shut off the water supply to the heater and, if necessary, drain water from the system.

4. Locate the pump junction box and wiring decal shown in Fig. 32.

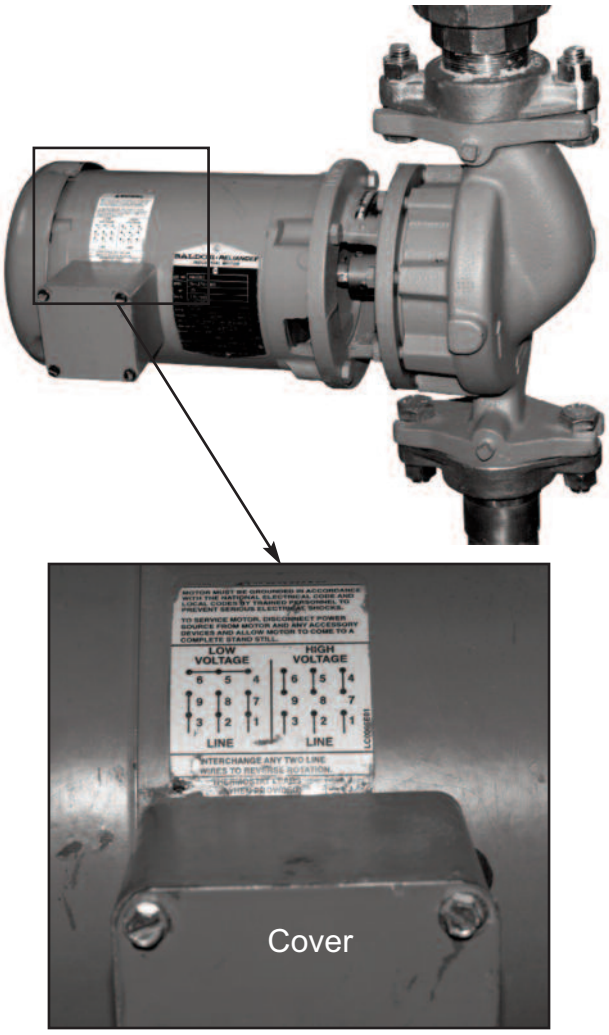


Fig. 32: Pump Wiring Decal and Junction Box

5. Remove the pump junction box cover shown in Fig. 32 and locate the 9 wires inside.
6. Wire in accordance with the low voltage (230 VAC) decal located next to the pump junction box (do not connect high voltage 460 volt power to the control box).
7. In the absence of the pump mounted decal, use Table F to complete the wiring between the cold water run control box and the 3-phase injector pump. Use wire nuts (field supplied) to complete these connections and ensure that all connections are tight.

230 VAC 3 ø Line	Low Voltage Pump Wiring
Black	Orange (3) and Gray (9)
Red	Red (8) and White (2)
White	Pink (7) and Blue (1)
_____	Yellow (4) and Black (5) and Violet (6)
Green	Ground Lug

Table F: Cold Water Run Control Panel and Injector Pump Wiring

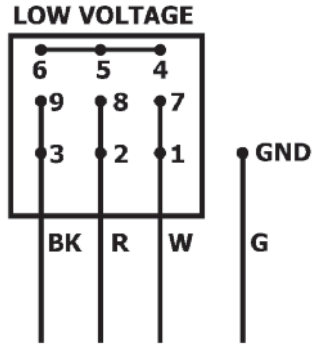


Fig. 33: Cold Water Run Control Panel and Injector Pump Wiring

8. Re-install the injector pump junction box cover.
9. Turn on the water and gas supply.
10. Turn the electrical supply on to the heater and to the cold water run system.
11. Turn heater on to receive a “call-for-heat” and verify the injector pump is rotating in the proper direction (clockwise). The pump volute has an arrow cast into the housing indicating the proper rotational direction. See Fig. 34.

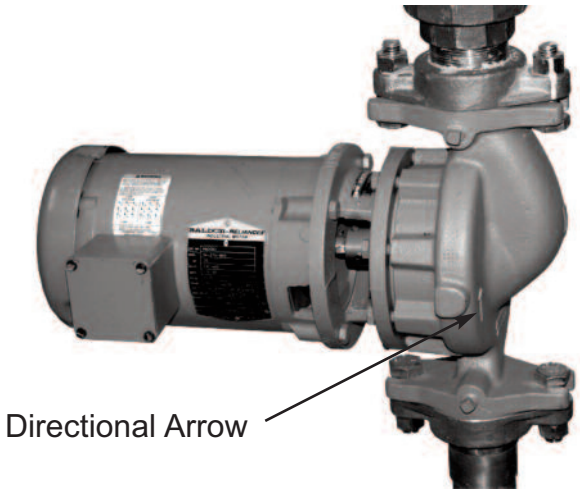


Fig. 34: Directional Arrow

12. If the pump is rotating in the proper direction, secure the heater from installation.
13. If the pump is rotating incorrectly, turn off power and swap ONLY two of the line voltage leads into the pump (for example, swap the red and black leads). Confirm that the pump now rotates in the proper direction before proceeding.
14. Secure from installation.

Injection Pump Cover Installation (Required for Outdoor Installation Only)

Before Starting

1. Turn off power to the unit at the circuit breaker.
2. Turn off gas supply.
3. Shut off the water supply to the heater and, if necessary, drain water from the system.
4. Allow heater to cool down before attempting work.

In order to install the pump cover, you will need to rotate the pump body so that the electrical box is pointing downward, as outlined in the following steps:

1. Loosen and remove the eight (8) 9/16" bolts holding the pump body in place. See Fig. 35.

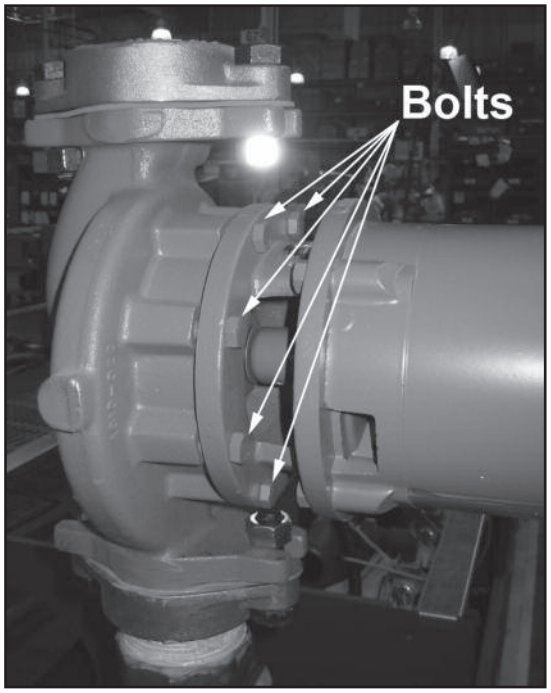


Fig. 35: Remove the eight bolts holding the pump body in place

2. Remove the pump body then rotate it so that the electrical box is pointing downward, ensuring not to damage the seal. See Figs. 36, 37 and 38.

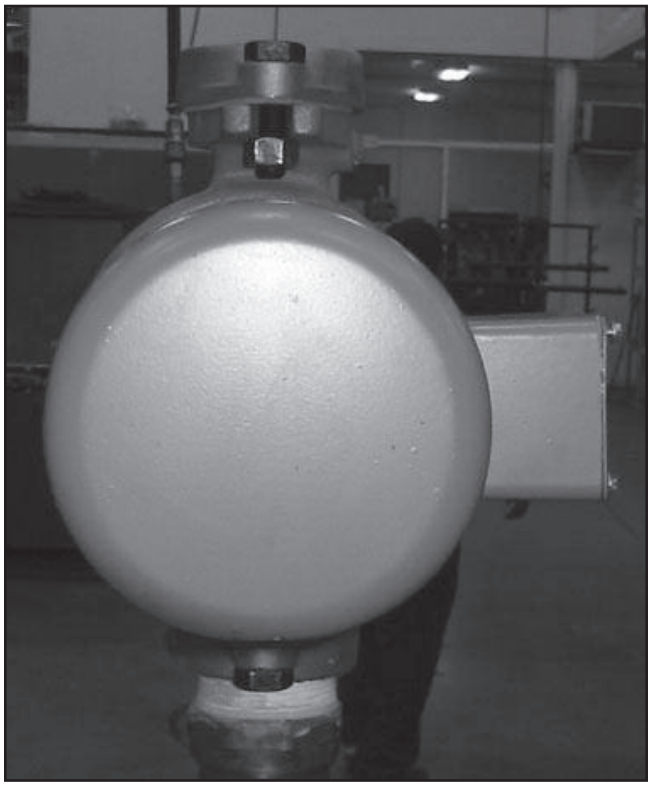


Fig. 36: Remove the pump body

Fig. 37: Be sure not to damage the seal when removing or replacing the pump body

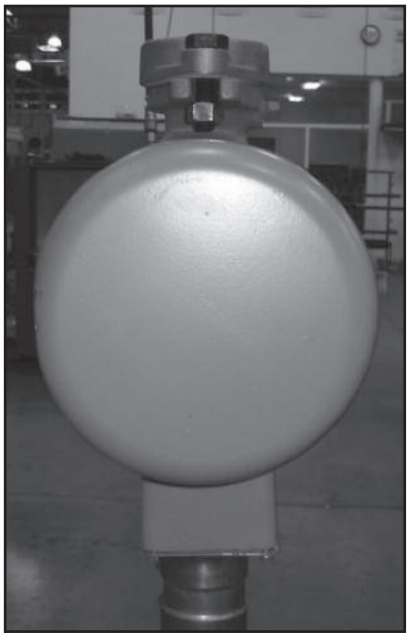


Fig. 38: Reposition the pump body so that the electrical box points downward

3. Insert and tighten all eight (8) bolts, securing the pump body in place.
4. You will now be able to install the pump cover. See Figs. 39 and 40.

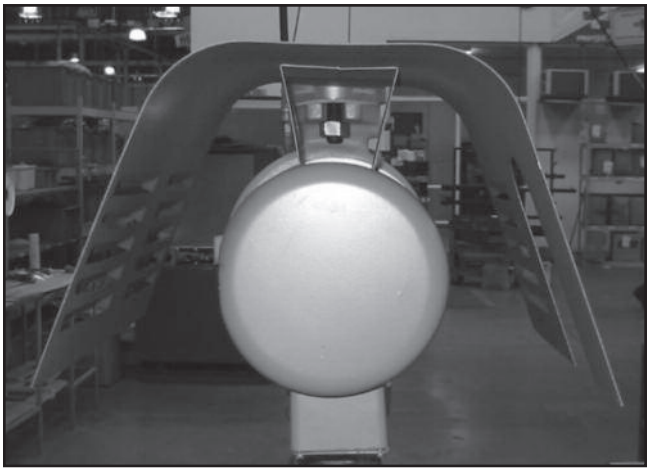


Fig. 39: Place the cover on the pump

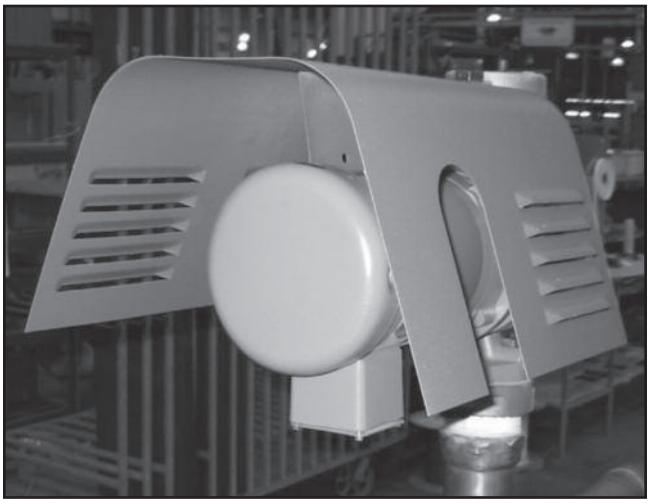
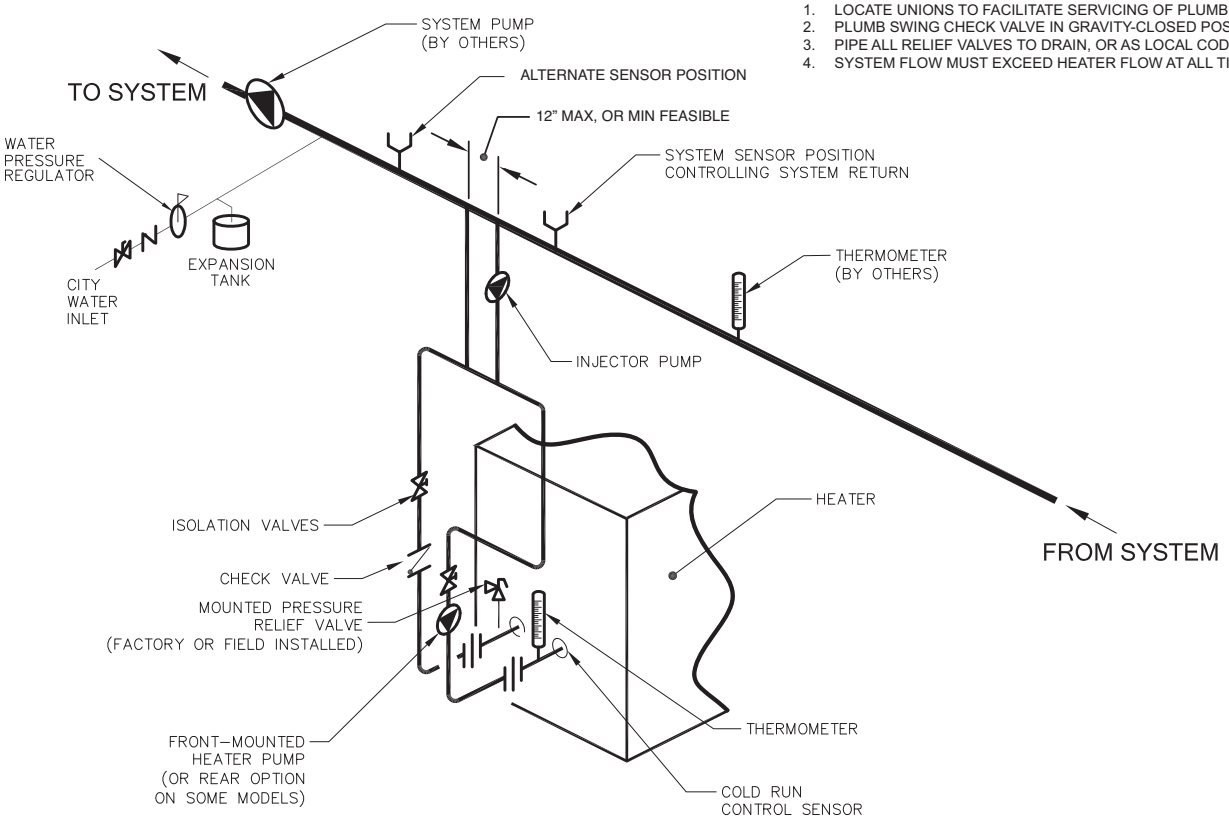


Fig. 40: Pump cover - angle view

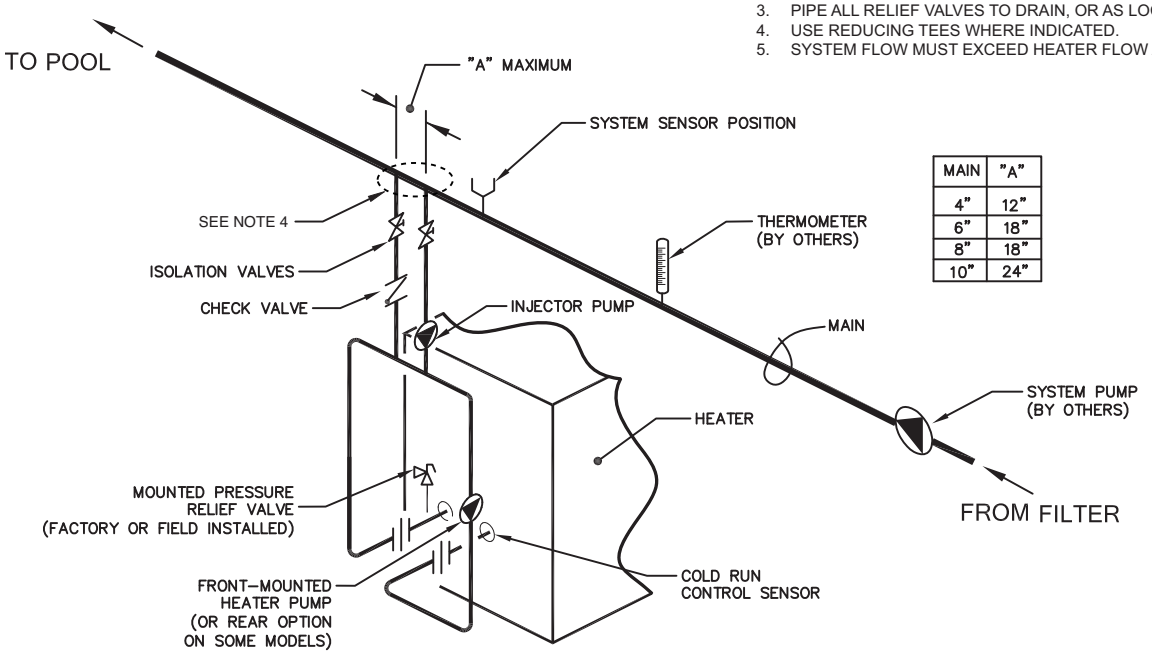
Typical Cold Water Run Piping - Heating Applications

NOTES:
1. LOCATE UNIONS TO FACILITATE SERVICING OF PLUMBING SIDE.
2. PLUMB SWING CHECK VALVE IN GRAVITY-CLOSED POSITION.
3. PIPE ALL RELIEF VALVES TO DRAIN, OR AS LOCAL CODES REQUIRE.
4. SYSTEM FLOW MUST EXCEED HEATER FLOW AT ALL TIMES.



Typical Cold Water Run Piping - Pool Applications

NOTES:
1. LOCATE UNIONS TO FACILITATE SERVICING OF PLUMBING SIDE.
2. PLUMB SWING CHECK VALVE IN GRAVITY-CLOSED POSITION.
3. PIPE ALL RELIEF VALVES TO DRAIN, OR AS LOCAL CODES REQUIRE.
4. USE REDUCING TEES WHERE INDICATED.
5. SYSTEM FLOW MUST EXCEED HEATER FLOW AT ALL TIMES.



MAIN	"A"
4"	12"
6"	18"
8"	18"
10"	24"

Operation

- Run full system flow for two minutes.
- Initiate PID pump control to achieve target inlet temperature by slowing injector pump.
- Boiler ΔT will not increase during bypass operation.
- If target temperature is not achieved after 7 minutes from “call for heat”, the system will shut down.

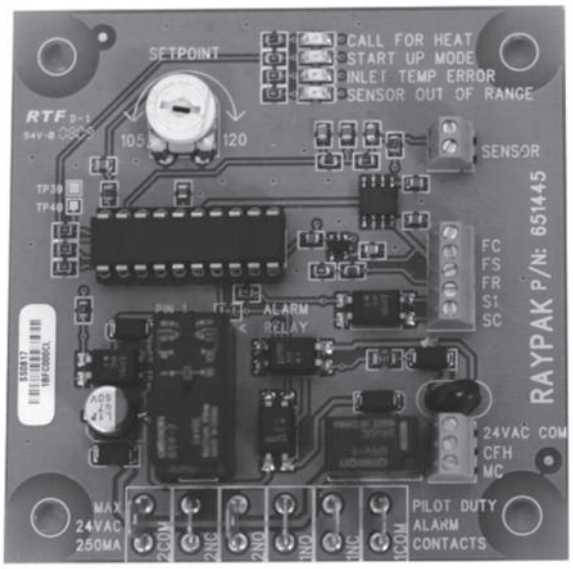


Fig. 41: Control Board

Cold Run Sequence of Operation

1. Supply separate 220VAC, 1 phase, 60 Hz power for the Hitachi Inverter (blue-colored inverter), or 120VAC or 220VAC, 1 phase, 60 Hz power for the AC Tech Inverter (white-colored inverter).
2. Call for heat occurs at heater.
3. The heater outputs 24VAC to terminal 4 of terminal block 3 located in Cold Run controller.
4. Terminal 4 of TB 3 sends 24VAC to the coil of the SPST relay located in the cold run control panel.
5. The SPST relay coil is energized and closes the contacts allowing 24VAC from the Cold Run control transformer to be sent to the CFH terminal of the Cold Run circuit board.
   a) A two second delay occurs from the CFH signal waiting to send power from terminal MC of the cold run circuit board.
6. 24 VAC is sent from terminal 2 of terminal block 3 to the NO contacts of the DPST relay located in the cold run control panel.
7. After the two second delay on the cold run circuit board, pin MC outputs a 24 VAC signal to terminal AL0 of the Hitachi inverter.
8. The AL0 relay closes and outputs a 24 VAC signal to the coil of the DPST relay located in the cold run control panel.
9. The DPST relay coil energizes and closes the NO contacts.
10. Once the NO contacts of the DPST close, the heater 24 VAC is sent back to the heater to complete the circuit (pin 3 of terminal block 3) and the interlock circuit (pin 1 & 2 of terminal block 3) allowing the heater to fire.
11. Pin SC of the cold run circuit board sends 10VDC to Pin 1 (Forward) on Hitachi Inverter.
12. PCS terminal on Inverter outputs 12VDC signal to the common terminal of the reset switch located on the bottom of the cold run control panel.
13. The 12VDC signal crosses over the reset switch and goes to Pin FS and to pin S1 on cold run circuit board.
14. Pin FR on the TVC board outputs 10VDC to pin O of the Inverter to drive injector pump at full speed for two-minutes waiting for the heater to reach full fire.
15. After the two-minute delay the 10VDC output signal from pin FR reduces to approximately 8VDC at the inverter thus slowing the pump to approximately 50 Hz.
16. The output signal continues to vary depending on the heater inlet temperature.

The heater will lockout and shut down if the set point on the inlet temperature is not achieved within 7 minutes from a call for heat.

The DIP switches on the Hitachi Inverter must be set as indicated on Fig. 42 below.

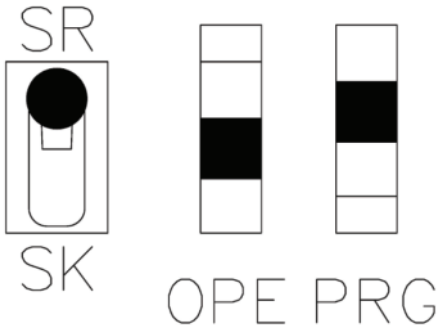
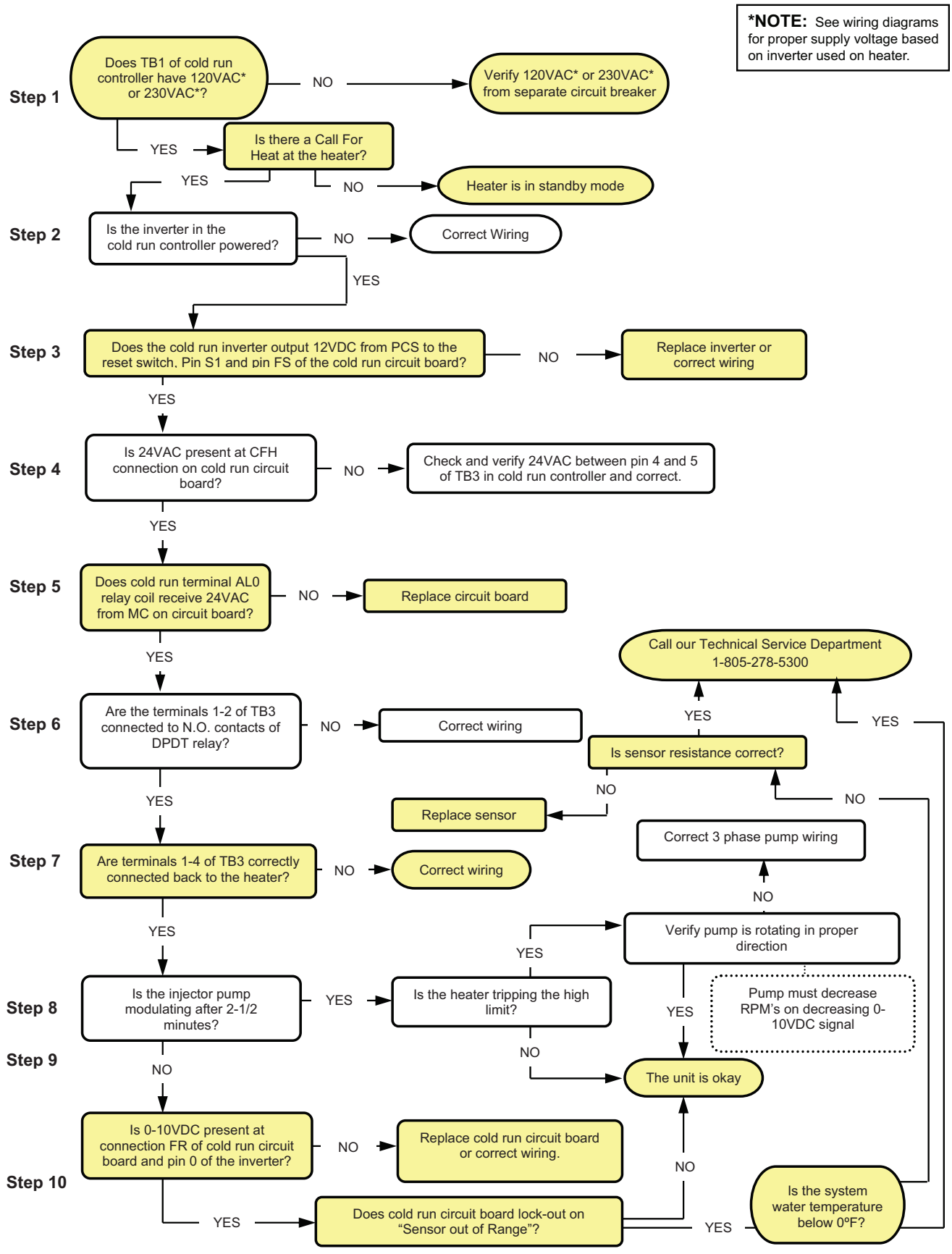
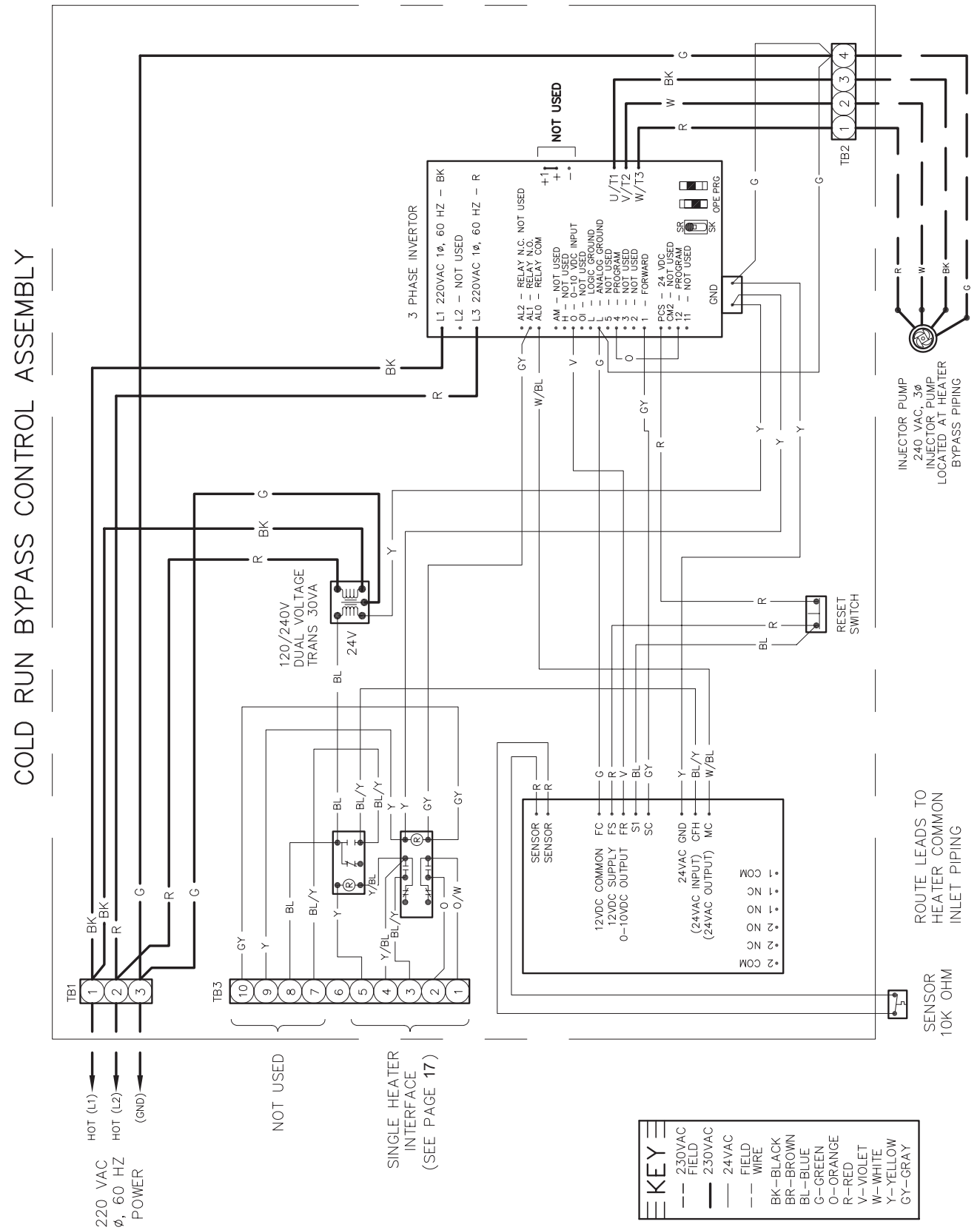


Fig. 42: DIP Switch Settings (Hitachi)

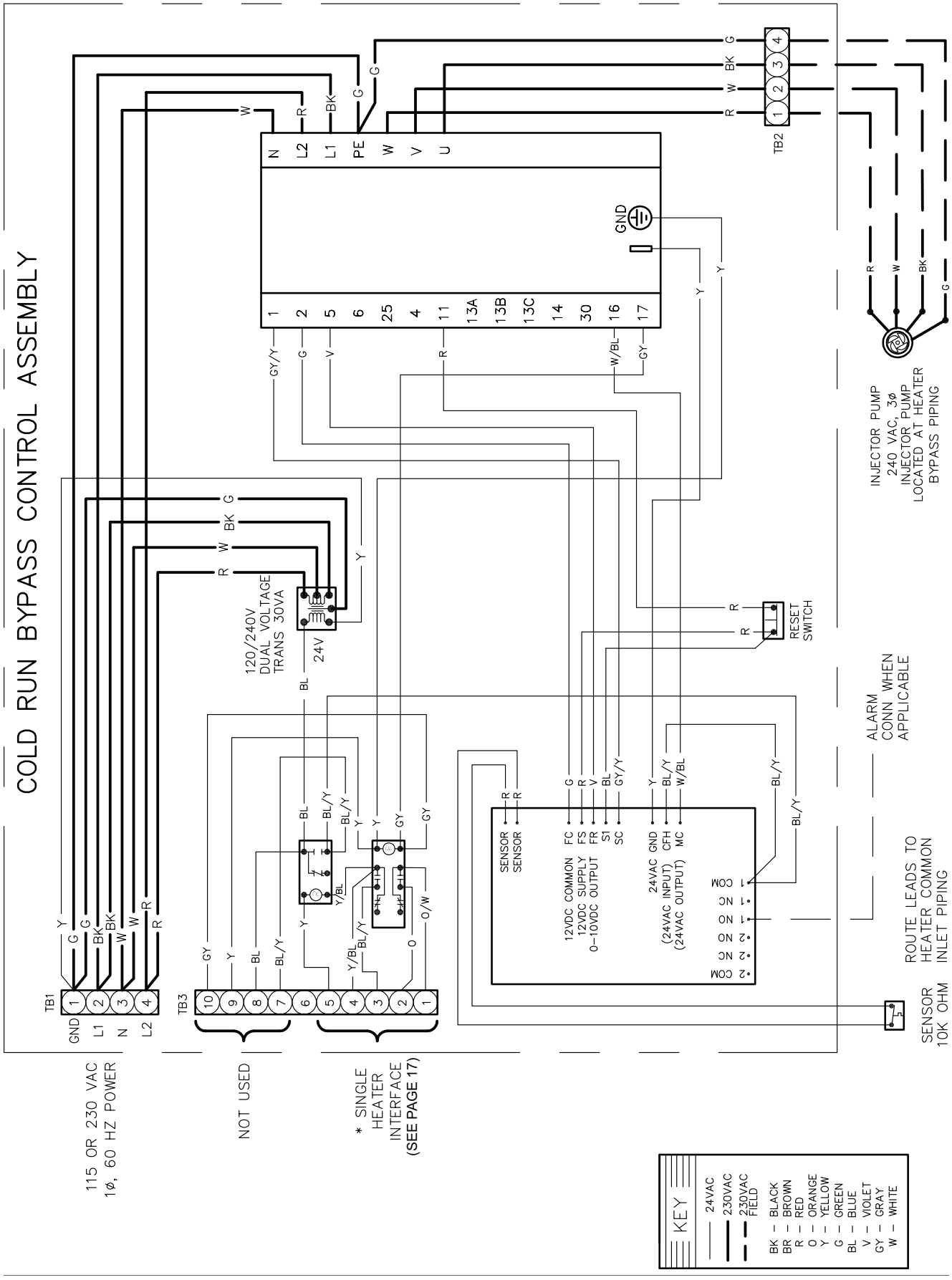
Cold Water Run Troubleshooting Guide


*NOTE: See wiring diagrams for proper supply voltage based on inverter used on heater.
Step 1
Does TB1 of cold run controller have 120VAC* or 230VAC*?
NO
Verify 120VAC* or 230VAC* from separate circuit breaker
YES
Is there a Call For Heat at the heater?
YES
NO
Heater is in standby mode
Step 2
Is the inverter in the cold run controller powered?
NO
Correct Wiring
YES
Step 3
Does the cold run inverter output 12VDC from PCS to the reset switch, Pin S1 and pin FS of the cold run circuit board?
NO
Replace inverter or correct wiring
YES
Step 4
Is 24VAC present at CFH connection on cold run circuit board?
NO
Check and verify 24VAC between pin 4 and 5 of TB3 in cold run controller and correct.
YES
Step 5
Does cold run terminal AL0 relay coil receive 24VAC from MC on circuit board?
NO
Replace circuit board
YES
Call our Technical Service Department 1-805-278-5300
Step 6
Are the terminals 1-2 of TB3 connected to N.O. contacts of DPDT relay?
NO
Correct wiring
YES
YES
Is sensor resistance correct?
YES
NO
Replace sensor
NO
Correct 3 phase pump wiring
Step 7
Are terminals 1-4 of TB3 correctly connected back to the heater?
NO
Correct wiring
YES
NO
Verify pump is rotating in proper direction
YES
Step 8
Is the injector pump modulating after 2-1/2 minutes?
YES
Is the heater tripping the high limit?
YES
Pump must decrease RPM's on decreasing 0-10VDC signal
NO
Step 9
NO
The unit is okay
Step 10
Is 0-10VDC present at connection FR of cold run circuit board and pin 0 of the inverter?
NO
Replace cold run circuit board or correct wiring.
NO
YES
Does cold run circuit board lock-out on "Sensor out of Range"?
YES
Is the system water temperature below 0ºF?

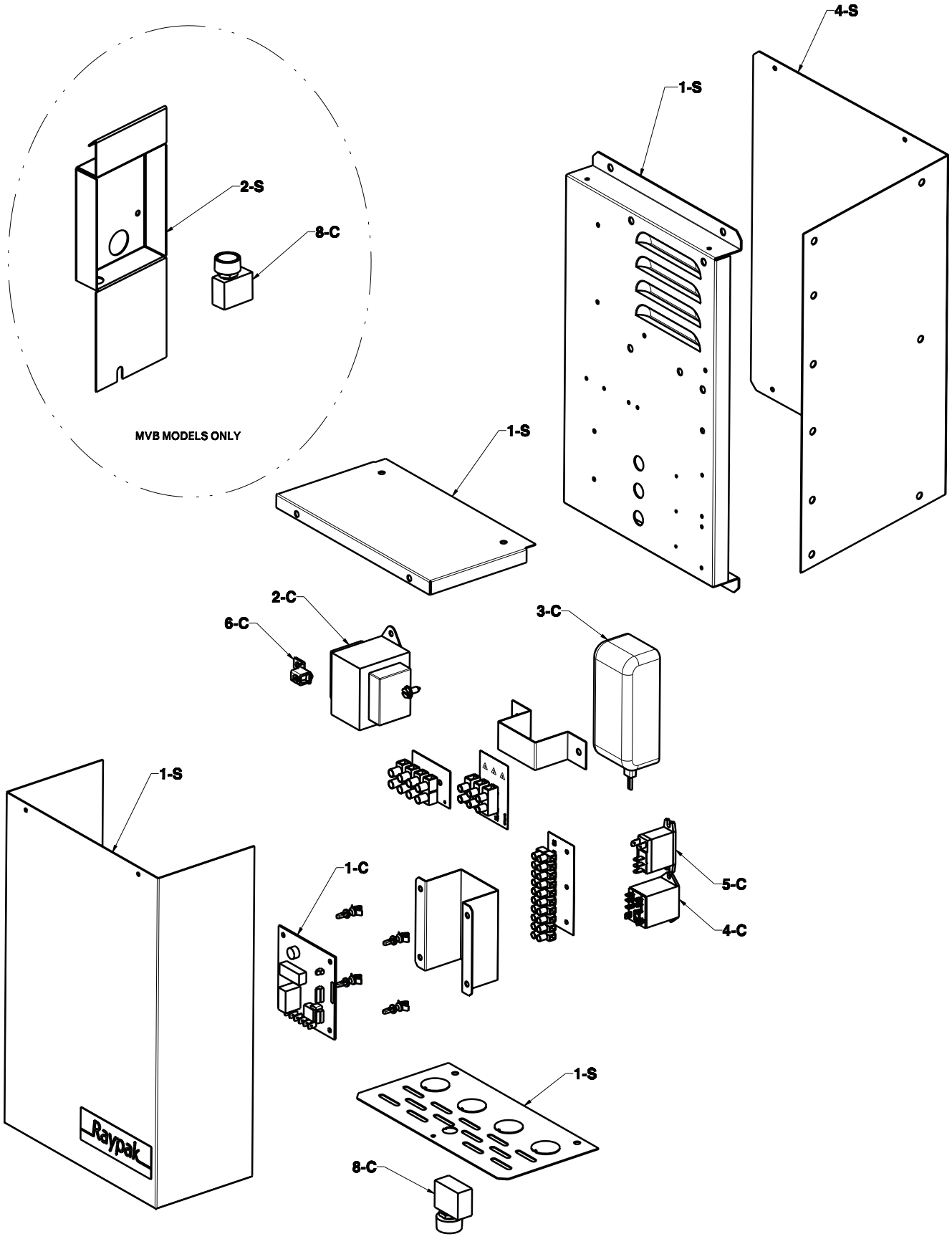
Wiring Diagram—Cold Water Run (Hitachi Inverter)



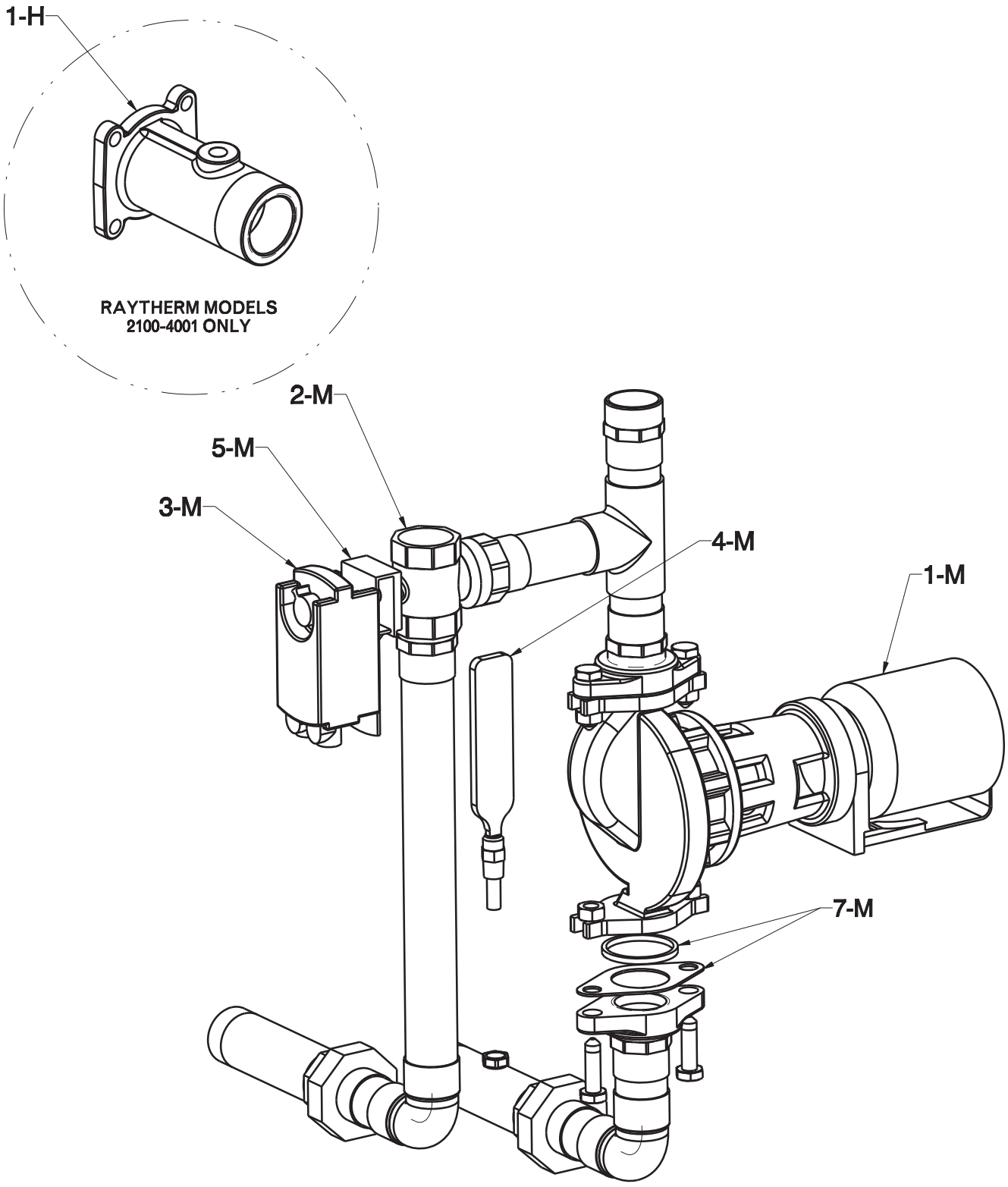
Wiring Diagram—Cold Water Run (AC Tech Inverter)



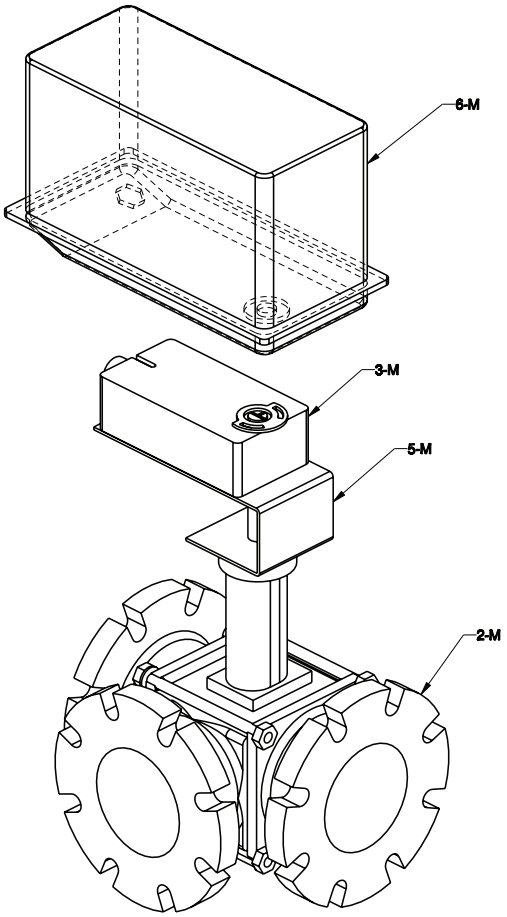
ILLUSTRATED PARTS LISTS Cold Water Start



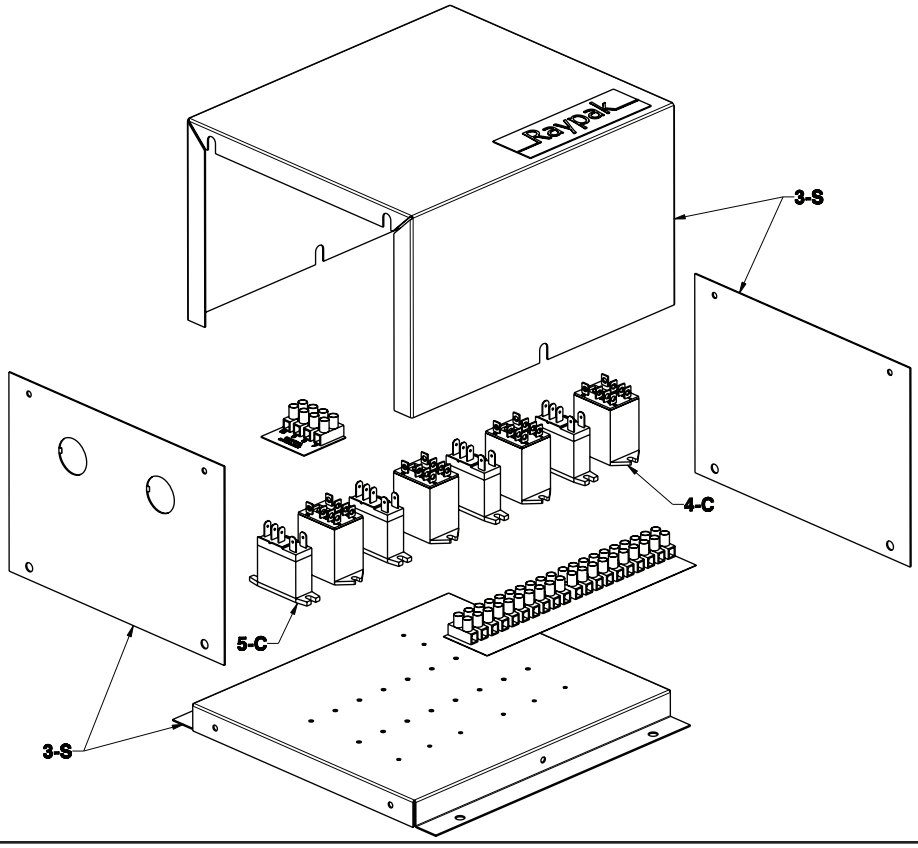
Cold Water Start



Cold Water Start



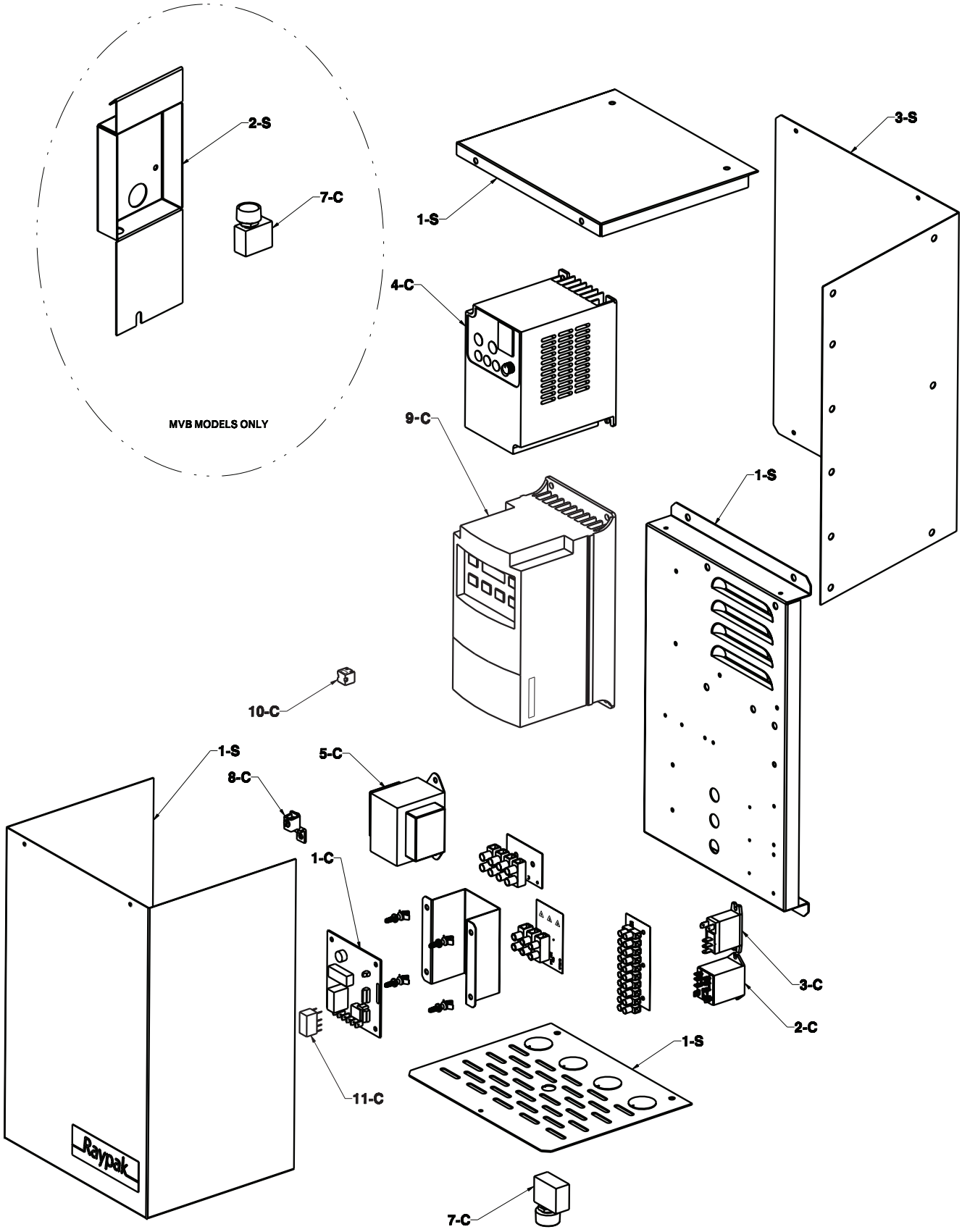
Multiple Boiler Interlock



CALL OUT	DESCRIPTION	HI DELTA	MVB	RAYTHERM
1-C	PC BOARD ASSY-CONTROL	011717F	011717F	011717F
9-C	RELAY - DPDT 24VDC COIL	005962F	005962F	005962F
2-C	TRANSFORMER	011718F	011718F	011718F
3-C	POWER SUPPLY 120VAC/12VDC	011719F	011719F	011719F
4-C	RELAY - DPDT 24V	011720F	011720F	011720F
5-C	RELAY - SPDT 24V	009039F	009039F	009039F
6-C	GROUND LUG	007155F	007155F	007155F
7-C	TEMP SENSOR 10K (NOT SHOWN)	010787F	010787F	010787F
8-C	ALARM RESET SWITCH	005641F	005641F	005641F
1-H	INLET ADAPTER 2-1/2 NPT	N/A	N/A	012315F
1-M	PUMP-WATER BR 2" FLANGE, 1/4 HP	007226F	007226F	007226F
	PUMP-WATER CI 2" FLANGE, 1/4 HP	007232F	007232F	007232F
	PUMP-WATER BR 2" FLANGE, 1/2 HP	N/A	007347F	007347F
	PUMP-WATER CI 2" FLANGE, 1/2 HP	N/A	007353F	007353F
	PUMP-WATER BR 2-1/2" FLANGE, 3/4 HP	007348F	007348F	007348F
	PUMP-WATER CI 2-1/2" FLANGE, 3/4 HP	007354F	007354F	007354F
	PUMP-WATER BR 2-1/2" FLANGE, 1 HP	007348F	007348F	007348F
	PUMP-WATER CI 2-1/2" FLANGE, 1 HP	007354F	007354F	007354F
	PUMP-WATER BR 2-1/2" FLANGE, 1.5 HP	N/A	007937F	007937F
	PUMP-WATER CI 2-1/2" FLANGE, 1.5 HP	N/A	007938F	007938F
	PUMP-WATER BR 2-1/2" FLANGE, 2.0 HP	N/A	N/A	012317F
	PUMP-WATER CI 2-1/2" FLANGE, 2.0 HP	N/A	N/A	012318F
7-M	PUMP FLANGE GASKET	013423F	013423F	013423F
2-M	THREE-WAY VALVE ASSY 2" NPT 24 Cv	011939F	011939F	011939F
	THREE-WAY VALVE ASSY 2" NPT 38 Cv	011721F	011721F	011721F
	THREE-WAY VALVE ASSY 2" NPT 57 Cv	011722F	011722F	011722F
	THREE-WAY VALVE ASSY 2-1/2" NPT 74 Cv	011723F	011723F	011723F
	THREE-WAY VALVE ASSY 2-1/2" NPT 100 Cv	011724F	011724F	011724F
	THREE-WAY VALVE ASSY 4" NPT 152 Cv	012231	012231	012231
	THREE-WAY VALVE ASSY 4" NPT 254 Cv	012232	012232	012232
	THREE-WAY VALVE ASSY 4" NPT 327 Cv	012233	012233	012233
3-M	ACTUATOR-35 IN LBS (ELODRIVE)	012447F	012447F	012447F
	ACTUATOR-53 IN LBS (DELTA CONTROLS)	011834F	011834F	011834F
	ACTUATOR-132 IN LBS (ELODRIVE)	012448F	012448F	012448F
	ACTUATOR-177 IN LBS (DELTA CONTROLS)	012449F	012449F	012449F
4-M	THERMOMETER-VERTICAL	000919	N/A	000919
5-M	MOUNTING KIT (ELODRIVE)	012450F	012450F	012450F
	MOUNTING KIT (DELTA CONTROLS)	012452F	012452F	012452F
	MOUNTING KIT 4" VALVE (ELODRIVE)	012451F	012451F	012451F
	MOUNTING KIT 4" VALVE (DELTA CONTROLS)	012453F	012453F	012453F
6-M	ACTUATOR COVER (DELTA CONTROLS ONLY)	012454F	012454F	012454F
	ACTUATOR COVER 4" (DELTA CONTROLS ONLY)	012455F	012455F	012455F
1-S	CONTROL BOX SHEET METAL	011716F	011716F	011716F
2-S	CONTROL BOX COVER	N/A	011978F	N/A
3-S	INTERLOCK BOX SHEET METAL	012249F	012249F	012249F
4-S	CONTROL BOX MTG BRACKET	N/A	N/A	012367F

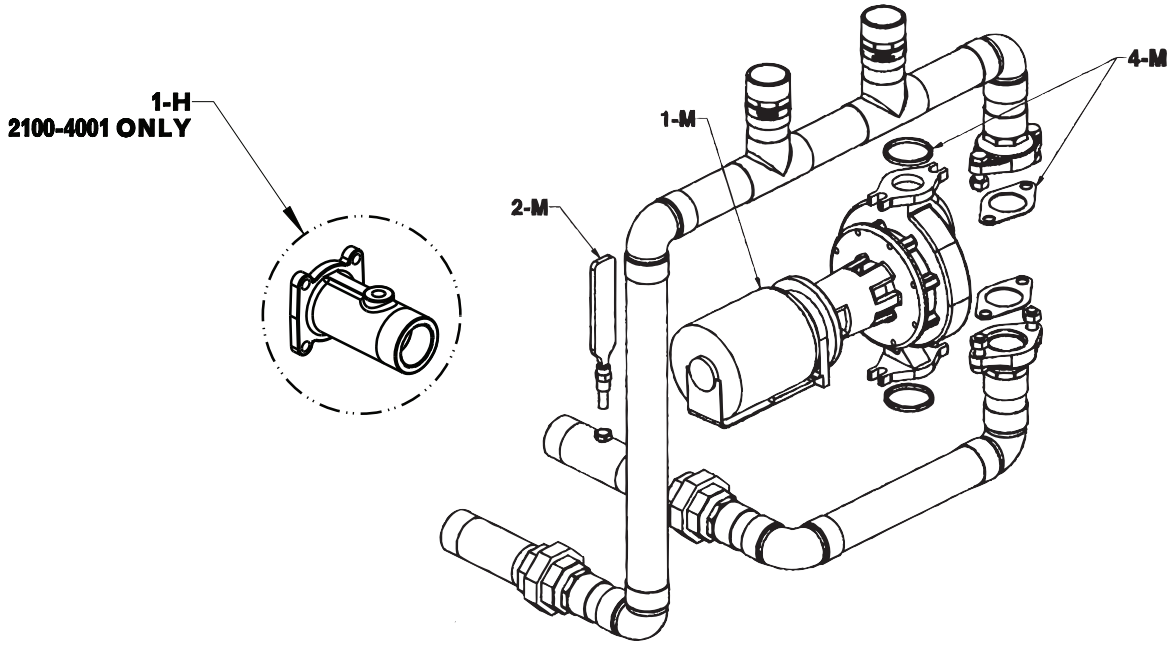
NOTE: Sizing is specific to the application.

Cold Water Run



CALL OUT	DESCRIPTION	HI DELTA	HI DELTA SS	MVB	RAYTHERM
1-C	PC BOARD ASSY-CONTROL	011717F	N/A	011717F	011717F
11-C	RELAY - DPDT 24VDC	005962F	N/A	005962F	005962F
2-C	RELAY - DPDT 24VAC	011720F	N/A	011720F	011720F
3-C	RELAY - SPDT 24VAC	009039F	N/A	009039F	009039F
4-C	INVERTER	011835F	N/A	011835F	011835F
9-C	INVERTER - DUAL VOLTAGE	012984F	N/A	012984F	012984F
10-C	CHIP - PROGRAMMED	013070F	N/A	013070F	013070F
5-C	TRANSFORMER	011718F	N/A	011718F	011718F
6-C	TEMPERATURE SENSOR 10K (NOT SHOWN)	010787F	N/A	010787F	010787F
7-C	ALARM RESET SWITCH	005641F	N/A	005641F	005641F
8-C	GROUND LUG	007155F	N/A	007155F	007155F
1-H	INLET ADAPTER-2-1/2 NPT (2100-4001)	N/A	N/A	N/A	012316F
1-M	PUMP - WATER BR 1-1/2" FLANGE, 1/8 HP	N/A	013425F	N/A	N/A
	PUMP - WATER CI 1-1/2" FLANGE, 1/8 HP	N/A	013426F	N/A	N/A
	PUMP - WATER BR 2" FLANGE, 1/4 HP	007226F	007226F	007226F	007226F
	PUMP - WATER CI 2" FLANGE, 1/4 HP	007232F	007232F	007232F	007232F
	PUMP - WATER BR 2-1/2" FLANGE, 3/4 HP	007348F	N/A	007348F	007348F
	PUMP - WATER CI 2-1/2" FLANGE, 3/4 HP	007354F	N/A	007354F	007354F
	PUMP - WATER BR 2-1/2" FLANGE, 1 HP	007351F	N/A	007351F	007351F
	PUMP - WATER CI 2-1/2" FLANGE, 1 HP	007357F	N/A	007357F	007357F
4-M	PUMP FLANGE GASKET (2" & 2-1/2" FLANGES)	013423F	013423F	013423F	013423F
2-M	THERMOMETER-VERTICAL	000919	000919	000919	000919
3-M	INJECTOR PUMP, SS 1/8 HP (NOT SHOWN) (HD251)	N/A	951446	N/A	N/A
	INJECTOR PUMP, CI 1/8 HP (NOT SHOWN) (HD251)	N/A	951447	N/A	N/A
	INJECTOR PUMP, BR 1/8 HP (NOT SHOWN)	N/A	951421	N/A	N/A
	INJECTOR PUMP, CI 1/8 HP (NOT SHOWN)	N/A	951424	N/A	N/A
	INJECTOR PUMP, BR 1/4 HP (NOT SHOWN)	951414	N/A	951414	951414
	INJECTOR PUMP, CI 1/4 HP (NOT SHOWN)	951415	N/A	951415	951415
	INJECTOR PUMP, BR 1/3 HP (NOT SHOWN)	951394	N/A	951394	951394
	INJECTOR PUMP, CI 1/3 HP (NOT SHOWN)	951413	N/A	951413	951413
	INJECTOR PUMP, BR 3/4 HP (NOT SHOWN)	951411	N/A	951411	951411
	INJECTOR PUMP, CI 3/4 HP (NOT SHOWN)	951416	N/A	951416	951416
1-S	CONTROL BOX SHEET METAL	012315F	N/A	012315F	012315F
2-S	CONTROL BOX COVER	N/A	N/A	011978F	N/A
3-S	CONTROL BOX MTG BRACKET	N/A	N/A	N/A	012367F

NOTE: Sizing is specific to the application.



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